

April 1995

# Mobile Radio Technology™

The journal of mobile communications technology

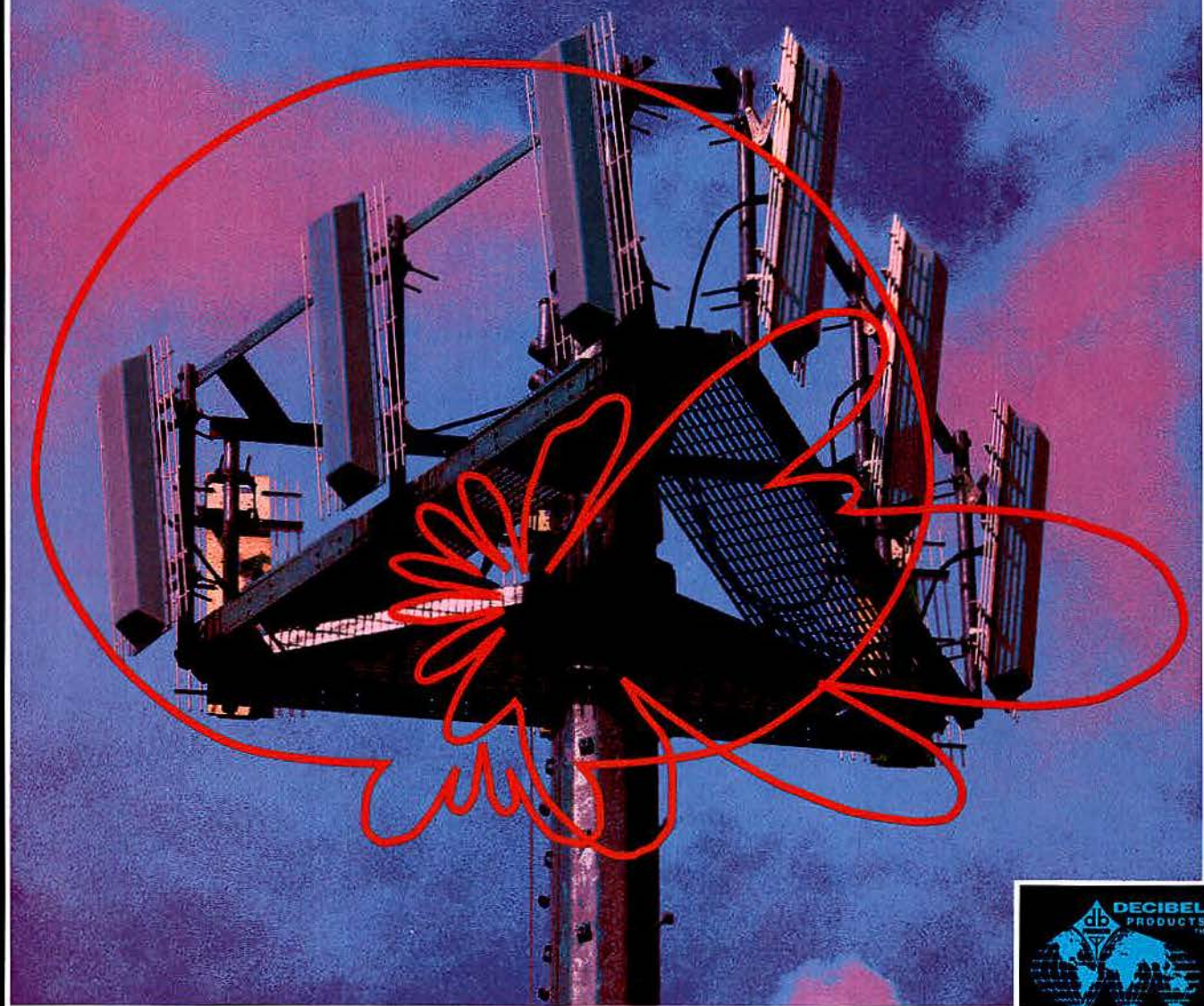
## Coaxial connectors, p. 10

---

- CDMA cellular
- Servicing pagers
- Lightning protection theory
- Pulling cable



# Decibel's Digital Dominator.<sup>™</sup> It Does It All.



## Introducing Decibel's New Antenna Combining Analog and Digital Compatibility.

The Digital Dominator antenna allows you to enjoy superior analog transmission now, while preparing your network for the inevitable demand for digital systems in the future.

With its well defined and rigorously maintained 70° beam width patterns, the Digital Dominator is an ideal choice for analog and digital systems covering high and medium density areas. Operating with 13 dBd gain from 820-900 MHz, the new 70° antenna is specifically designed to reduce interference that may occur in overlapping coverage areas.

Easy to mount, extensively tested for the absence of intermodulation, and featuring rugged construction to withstand the elements, this antenna is designed to meet all your requirements.

Call Decibel today at (214) 631-0310.  
And take charge of RF coverage with this antenna –  
from the industry's reliability leader.



P.O. Box 569610  
Dallas, Texas 75356-9610  
Order Hotline 1-800-676-5342  
Order FAX 1-800-229-4706  
214-631-0310  
FAX 214-631-4706

Visit us at ENTELEC, Booths #1030 & #1032.

Visit us at IWCE/Spring, Booth #1035.

Your Wireless Connection.<sup>™</sup>

Circle (1) on Fast Fact Card



# The 10-site radio controller



## Vega's C-5111 10-line/4-frequency console

Vega's Model C-5111 compact, easily rack-mounted, ten-line/four-frequency radio control console provides instant PTT, timed mute, and other most-needed features. This tone-format console allows you to quickly select one or any combination of up to 10 remote base stations. A second speaker allows you to monitor (with individual volume controls) any combination of those 10 stations that are not already selected for TX/RX control. Instant PTT switches allow immediate response to a call on a particular "selected" or "unselected" line, without disturbing the programming of the "selected" simulcast group or line.

Standard features available on the cost-effective and versatile C-5111 console include:

- **SELECTED switches** for selecting any combination of lines for transmitting and receiving
- **UNSELECTED switches** for monitoring any combination of unselected lines

- **TX ALL (simulcast) switch** for selecting all lines for both transmit and receive
- **RX ALL switch** for monitoring all unselected lines
- **Separate speakers and volume controls** for "selected" (TX/RX) and "unselected" (RX-only) audio
- **GROUP SELECT switch** for easy selection of TX/RX line combinations
- **TIMED MUTE switch** to mute "unselected" audio temporarily
- **Separate volume controls** for each "unselected" line
- **Instant-PTT switches** for each line
- **Line-activity LEDs** (function on all lines, selected or not)
- **Heavy-duty 120/240-V<sub>ac</sub> power supply** (also runs on 12 V<sub>dc</sub>)

### Options

- **DCA-3 external three-line adapter** for DC-format lines

- Gooseneck and desk microphones, headsets, footswitch
- DTMF pad
- Cross mute
- Clock, audio-level bargraph, and cross-mute indicators
- Rack-mount kit

The C-5111 has the flexibility to accommodate most any multiline console requirement. Call 1-800-877-1771 (toll-free) now for full details on the C-5111 console.



a **MARK IV** company  
**Signaling Products Group**

9900 East Baldwin Place  
 El Monte, California 91731-2294  
 Telephone: (818) 442-0782  
 Toll-Free Telephone: 800-877-1771  
 Fax: (818) 444-1342  
 FaxBack: (818) 444-2017  
 Toll-Free FaxBack: 800-274-2017

Circle (4) on Fast Fact Card



## features

### 10 Coaxial connectors: 7/16 DIN and type N

*Jeffrey D. Paynter and Richard Smith*  
Part 1—Use of the 7/16 DIN connector is increasing. It offers many technical advantages over the type N interface.

### 14 Test challenges for CDMA cellular

*Kenneth S. Thompson*  
Some of the traditional methods of evaluating cellular radio performance are radically altered from existing methodologies.

### 28 Pulling cable to install two-way radio equipment

*Ronald Steen*  
As a rule, developing good wire-pulling skills is important when working on radios, amplifiers and antennas.

### 32 IWCE/Spring preview and guide

More than 300 mobile communications equipment manufacturers, distributors and service providers will convene at the Las Vegas Sands Convention Center as they gear up for 1995. Use our pull-out map and exhibitor list as an exhibit hall guide.

### 66 Servicing pagers: Essential differences

*David Ludvigson*  
Part 14—Here are some tips for programming Bravo Plus and Bravo Express pagers.

### 74 Lightning protection theory: More fuel for the debate

*Bruce A. Kaiser*  
A clear understanding of the operational theory of streamer-delaying products might lead the technology's opponents to devote some of their energy to figuring out how and why it works.

## departments

### 4 Editorial

### 6 Calendar

### 8 Technically speaking

*Harold Kinley, C.E.T.*  
More about intermodulation.

### 84 Regulating technology

*Robert H. Schwaninger Jr.*  
Connecting AVM in the DMZ.

### 86 News

### 87 New products

Andrew, Motorola and Advanced Electronic Applications are the "Readers' Choice."

### 91 Literature

### 92 People

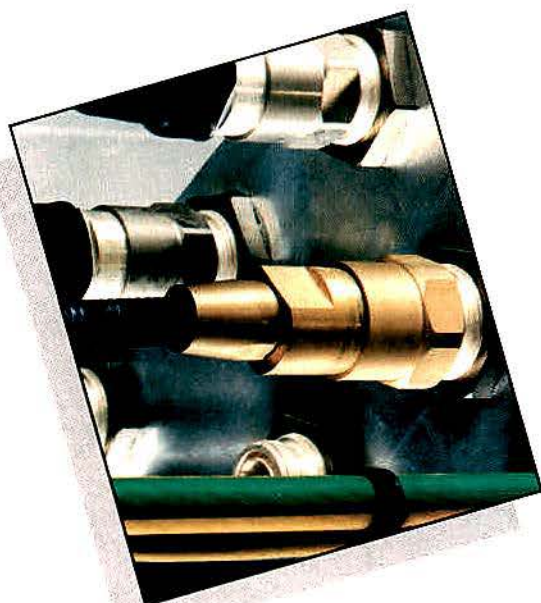
### 93 Letters from readers

An allegory.

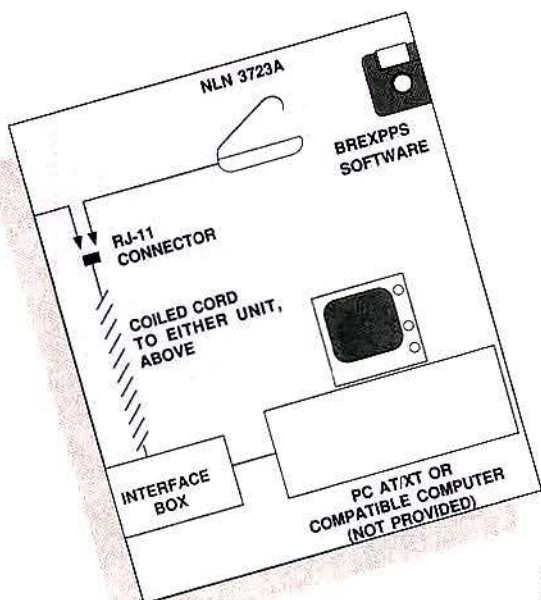
### 95 Classified ads

### 116 Ad index/hot line

Find advertisers quickly.



page 10



page 66

**On the cover:** Weatherproofing connectors for outdoor coaxial cable installations may not be enough to ensure the integrity of an installation. Vibration-resistance by 7/16 DIN connectors can prevent connectors from loosening under vibration. See Jeffrey Paynter and Richard Smith's article on page 10. *Photo courtesy of Andrew Corporation, Orland Park, IL.*

Mobile Radio Technology (ISSN 0745-7626) is published monthly by Intertec Publishing Corporation, 9800 Metcalf, Overland Park, KS 66212-2215, and mailed free to qualified persons within the United States and Canada. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address change to Mobile Radio Technology, P.O. Box 12960, Overland Park, KS 66282-2960. SUBSCRIPTIONS: Non-qualified persons may subscribe at the following rates: United States and Canada: one-year: \$30.00. Qualified and non-qualified persons in all other countries: one-year: \$40.00 (surface mail); \$105.00 (air mail). Subscription information: P.O. Box 12937, Overland Park, KS, 66282-2937.

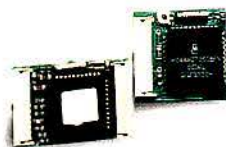


# MOBILE DATA SOLUTIONS For *Real-Life* Situations

Call 1-800-228-0226



*TransPulse™*



*Two-Way Radio Signaling Modules*



*Mobile Status Head*

When real-life situations call for immediate response, make Transcript's mobile data products part of your solution. These versatile and rugged products easily become part of any mobile data system—for public safety, highway, mass transit, delivery, service organization, or utility.

TransPulse™ is the first touch-screen data communication system specifically designed for the rigors of mobile operation. It's easily customized for specific applications.

T-CAD™ allows computer-aided dispatch on a standard PC. Using keyboard and mouse, dispatchers have easy access to all features and commands.

Mobile Status Head lets you manage your fleet more productively. Report changes in status or location—at the touch of a button.

Two-Way Radio Signaling Modules provide such features as selective calling, automatic number identification, digital

encode/decode and over-the-air-reprogramming and are available for more than 1,400 radio models. At the push of a button, dispatchers are immediately alerted to emergencies.

Learn how Transcript products can help you streamline your radio fleet operation. Call 1-800-228-0226 (outside the USA, call 001-402-474-4800), and ask for the MOBILE DATA DESK.

**TRANSCRIPT™**  
INTERNATIONAL

A WORLD LEADER IN WIRELESS AND SECURE COMMUNICATIONS

4800 NW 1st Street, Lincoln, NE 68521 USA  
(402)474-4800 • FAX (402)474-4858



## Trade groups align themselves on issues affecting small SMRs



Several national trade associations and groups represent specialized mobile radio (SMR) system operators. Among them are the American Mobile Telecommunications Association (AMTA), the Council of Independent Communication Suppliers (CICS), the Personal Communications Industry Association (PCIA), the Specialized Mobile Radio Wireless Operators Network (SMR WON), and the United States Independent Personal Communications Association (USIPCA).

Their positions on several issues facing SMR system operators are summarized in the box below.

Large businesses would benefit, and small businesses might even be driven out of business, with the adoption of proposals to auction 800MHz SMR spectrum, to require frequency changes for existing 800MHz SMR systems and to assign 800MHz SMR spectrum in 50-channel blocks for wide-area use.

Unless the small SMR operators can (a) overturn the wide-area service waivers that allow large operators to hold frequencies without building systems ("warehousing") and (b) defeat the auction proposal, they are not likely to gain access to frequencies necessary not only for expansion but for survival. Large SMR operators need only achieve (b) to benefit.

With respect to mandatory relocation, by taking no position AMTA shows an ambivalence that reflects its representation of large and small SMR operators. Its largest member, having adopted a digital technology that apparently does not work well in a frequency band it shares with systems using analog technology, is pressing the FCC to require operators of analog systems on those frequencies to relocate to other frequencies. The FCC may be in-

clined to do so, absent (and maybe despite) strong opposition.

PCIA also represents large and small SMR operators. Surprisingly, the association has taken a position opposing mandatory relocation—and we congratulate PCIA for doing so.

SMR WON was formed last year specifically to support small SMR operators' efforts to overcome frequency warehousing by large SMR operators that use wide-area service waivers to apply for licenses for thousands of frequencies at a time. Large SMR operators have been granted licenses to install repeaters at sites that surround the small SMRs. These licenses preclude the small SMRs from adding capacity to their systems, despite the obvious impracticality for the large SMRs ever to activate more than a fraction of the repeaters for which they hold licenses in many parts of the country.

SMR WON not only opposes auctions and mandatory relocation, it apparently is the only group to propose a method for freeing a portion of the vacant channels controlled by the large SMRs for immediate use by small businesses. SMR WON wants the FCC to limit licenses for wide-area systems to 50 channels in a given locality and to rescind licenses already granted in excess of that number. SMR WON proposes that the FCC issue tax certificates as compensation to holders of licenses that are rescinded.

CICS opposes auctions, but it is not resolved in its opposition to mandatory relocation. If relocation were required to be

completed within a year, CICS would oppose it. CICS does not necessarily oppose a more extended mandatory relocation period. CICS supports the FCC's proposal to designate a block of frequencies for wide-area SMR systems. As a solution to frequency warehousing by large SMR operators, it suggests that small SMR operators enter into management agreements with large SMR operators or that they move their systems to other frequencies, if available.

USIPCA represents small business mobile communications service providers, and its Small Business SMR Council represents members with SMR licenses. USIPCA opposes auctions for 800MHz SMR spectrum and mandatory relocation. It has taken no position on the assignment of spectrum blocks for wide-area systems. Because it has not filed comments with the FCC expressing its positions, though, it cannot be considered as providing a voice for SMR operators on these issues.

Whether small SMR operators will gain the relief they need to stay in business and to expand is uncertain. Continued assignment of licenses by application without auction will help. So will keeping their systems on current frequencies to avoid technical disruption and loss of customer goodwill. They also need access to vacant channels being warehoused by the large SMR operators. At this juncture, SMR WON seems to be the group most in tune with the needs of the small SMR operators.

—Don Bishop

	AMTA	PCIA	SMR WON	CICS	USIPCA
<b>Auctioning of 800MHz licenses</b>	oppose	oppose	oppose	oppose	oppose
<b>Mandatory relocation of existing SMR providers</b>	no position	oppose	oppose	oppose <sup>1</sup>	oppose
<b>Assignment of 50-channel blocks for wide-area service</b>	support	oppose <sup>2</sup>	oppose <sup>3</sup>	support	no position

<sup>1</sup>CICS opposes a "quick" mandatory relocation, but seems willing to consider mandatory relocation over an extended period.

<sup>2</sup>PCIA supports an assignment of 10-channel blocks for wide-area service.

<sup>3</sup>SMR WON opposes auctioning any spectrum blocks. If spectrum-block auctions are adopted, SMR WON proposes blocks smaller than 50 channels, preferences for small business and minority applicants and certain exclusions for Nextel Communications and its affiliates.



# Be part of our world: Join the Motorola Test Network.

You're invited to become a member of the Motorola Test Network: The exciting new membership that ensures you'll receive advanced product information, video kits, application papers, posters, news briefs, invitations to special events and much more -- often in advance of their official release. Plus Test Network membership absolutely *free of charge!*

Find out more about the rugged, dependable family of Motorola Communication Systems Analyzers, priced starting at \$8,695 for the R-2550 and \$10,950 for the R-2600 (options extra). And be sure to ask about our new Micro RF Isolator portable screen room!

Simply call, FAX or mail the information requested below...and we'll *instantly* add your name to our select group of Motorola Test Network members. Sign up today.  
**Or visit us in our Exhibit #3075 at IWCE.**

**YES! I want to be part of the *Motorola Test Network!***

I am planning to buy test equipment (check one):

- ☐ In the next month      ☐ In 7-12 months  
☐ In 2-6 months      ☐ More than a year from now

**My testing application(s) is/are:**

- ☐ Two-way radios      ☐ Pagers  
☐ Cellular phones      ☐ Other (please specify) \_\_\_\_\_  
☐ Cellular base sites

**Who is responsible for purchasing test equipment within your organization?**

- ☐ I am      ☐ Other (please give name and title) \_\_\_\_\_

☐ Please call me to arrange a demo.

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Telephone \_\_\_\_\_ FAX \_\_\_\_\_

Communication Test Equipment  
P.O. Box 2606  
Scottsdale, AZ 85252-2606

**1-800-235-9590 Ext. 232**  
**1-602-441-7138 FAX**



**MOTOROLA**



## April

- 3-5—**Energy Telecommunications and Electrical Association**, George R. Brown Convention Center, Houston. Contact: 214-235-0655.  
25-27—**International Wireless Communications Expo/Spring**, Las Vegas Sands Convention Center, Las Vegas. Contact: 800-828-0420.

## May

- 17-19—**Mobile Communications Conference**, sponsored by the Personal Communications Industry Association (PCIA), Hotel del Coronado, San Diego. Contact: Nancy Palleschi, 800-759-0300.  
22-25—**Association of Public-Safety Communications Officials—International East Coast regional conference**, Marriott's Hunt Valley Inn, Hunt Valley, MD. Contact: Alan T. Kealey, 410-799-3466.  
31-June 2—**Radiocomm**, Toronto Metropolitan Convention Center, Toronto. Contact: 613-233-4888.

## July

- 26-28—**Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Hyatt Regency Chicago O'Hare, Chicago. Contact: Keith Puglusch, chairman, 312-399-2378.  
31-Aug. 4—**Utilities Telecommunications Council**, Hyatt Regency and Convention Center, Minneapolis. Contact: 202-872-0030.

## August

- 13-18—**Association of Public-Safety Communications Officials—International National Conference**, Detroit. Contact: 800-949-2726.

## September

- 20-23—**Personal Communications Showcase**, sponsored by the Personal Communications Industry Association (PCIA), Orange County Convention Center, Orlando, FL. Contact: 800-326-8638.

## October

- 18-20—**International Wireless Communications Expo/Fall**, Tampa

- Convention Center, Tampa, FL. Contact: 800-828-0420.  
26—**ERA Communications Trade Fair**, Ala Moana Hotel, Honolulu. Contact: 310-287-1218.  
29-Nov. 1—**Wireless Apps**, sponsored by the Cellular Telecommunications Industry Association, The Mirage Hotel, Las Vegas. Contact: 202-785-0081.

## November

- 7-9—**WirelessWorld Conference and Exposition**, sponsored by *Cellular Business* and *Mobile Radio Technology* magazines, Moscone Convention Center, San Francisco. Contact: Chris Lotesto, 800-458-0479.  
8-12—**Communications Marketing Conference**, sponsored by the Communications Marketing Association, Albuquerque, NM. Contact: Bernie Brownson, 303-371-8182.  
17—**Radio Club of America**, Communications Symposium, 86th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Ron Formella, 201-652-6811.

## 1996

## March

- 23-25—**Wireless '96**, sponsored by the Cellular Telecommunications Industry Association, Dallas. Contact: 202-785-0081.

## April

- 24-26—**International Wireless Communications Expo/Spring**, Las Vegas Convention Center, Las Vegas. Contact: 800-828-0420.

## June

- 24-27—**Supercomm**, sponsored by USTA and TIA, Dallas Convention Center, Dallas. Contact: 202-326-7300.



## Mobile Radio Technology™

The journal of mobile communications technology

### EDITORIAL

Don Bishop, *Editorial Director*  
David Keckler, *Senior Associate Editor*  
Ellen Payne, *Associate Editor*  
Harold Kinley, C.E.T., *Contributing Editor*  
David Ludvigson, *Contributing Editor*  
Roald Steen, *Contributing Editor*

### INDUSTRY CONSULTANT

Fred M. Link

### REGULATORY CONSULTANT

Robert H. Schwaninger Jr., *Brown and Schwaninger, Washington, DC*

### EDITORIAL ADVISORY BOARD

Gene A. Buzzi, *President, Omnicom Telecommunications Engineering, Tallahassee, FL*  
Jack Daniel, *The Jack Daniel Company, Cucamonga, CA*  
Gary David Gray, P.E., *Chief Telecommunica-*

*tions Engineer, Orange County Communications, Orange, CA*  
Frederick G. Griffin, P.E., *President, Frederick G. Griffin P.C., Lynchburg, VA*  
Mary Kjorvestad, *Empire Mobile Communications, Houston*  
Larry Kline, *Beachwood, OH*  
S.R. McConoughey, P.E., *Mobile Communications Consulting, Gaithersburg, MD*  
Art McDole, *Salinas, CA*  
Herb Sachs, *Herb Sachs Consulting, Bowie, MD*  
Robert C. Shapiro, P.E., *President, Strategic Telecommunications, Dallas*  
Leon Spencer, *Exxon Computing Services Company, Houston*  
Dr. Gregory M. Stone, *Senior Associate, Booz, Allen & Hamilton, McLean, VA*  
Raymond C. Trott, P.E., *President, Trott Communications Group, Irving, TX*  
William A. Wickline, P.E., *Mentor, OH*

**CORRESPONDENCE:** Editorial and advertising correspondence should be addressed to P.O. Box 12901, Overland Park, KS 66282-2901, 913-341-1300, fax: 913-967-1904.

**MOBILE RADIO TECHNOLOGY** provides technical information to dealers, community repeater operators, specialized mobile radio operators, conventional and cellular RCC and WCC, mobile radio equipment manufacturers, manufacturers' reps, distributors, engineering/consulting firms, national/

state/local government, military agencies, public safety agencies, transportation companies, petroleum/energy products companies, public utilities and others allied to the field.

**PHOTOCOPY RIGHTS:** Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by Intertec Publishing, provided that the base fee of US \$2.00 per copy, plus US \$00.00 per page is paid directly to Copyright Clearance Center, 222 Rosewood Dr., Danvers, MA 01923, USA. The fee code for users of the Transaction Reporting Service is 0745-7626/1995 \$2.00 + \$00.00. For those organizations that have been granted a photocopying license by CCC, a separate system of payment has been arranged. Prior to photocopying items for educational use, please contact CCC at 508-750-8400. Organizations or individuals with large quantity photocopy or reprint requirements should contact Chris Lotesto, 312-435-2359.



\$3.00 + 0.00

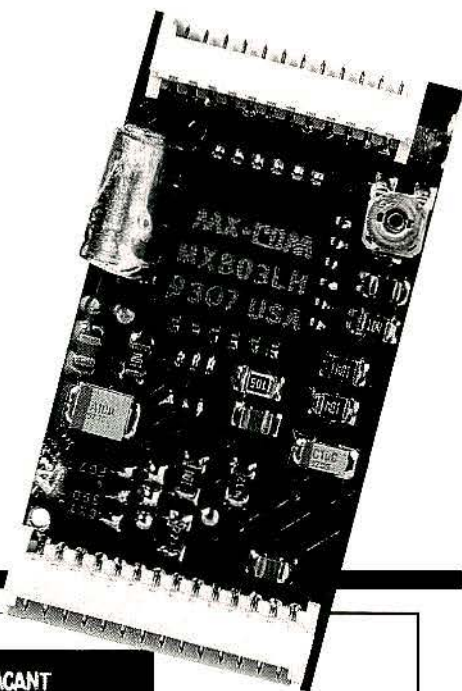
Audited circulation.



© 1995 by Intertec Publishing.  
All rights reserved.



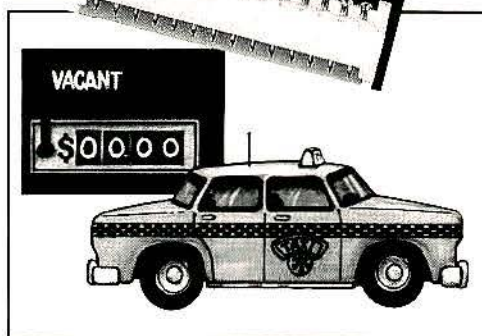
# More Than ANI



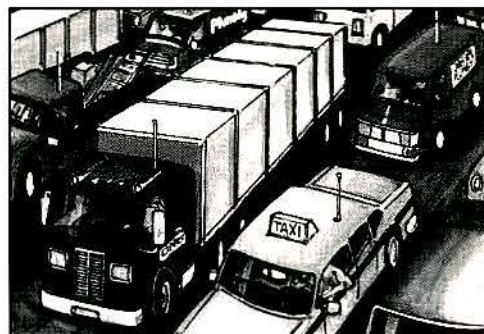
The MXP25 provides fast unit identity (ANI), but doesn't stop there.

As your call management needs expand, the MXP25 expands with them. The *Hot Key* feature senses and reports ignitions that are OFF or ON. Add a *Map/Stat/Keyboard* and report fleet conditions in the blink of an eye. Assure worker safety with *Man-Down/Hot Mic Alarms*.

ANI today—the whole banana tomorrow! Your needs may change, but with the expanded features of the MXP25, you'll be ready.



**SELECTIVE CALLING**



**STATUS**



**SAFETY—Man-Down/Hot Mic**

**For More Than Just ANI**  
**Call Toll Free:**  
**1-800-638-5577**

**MX-COM, INC.**

4800 Bethania Station Road, Winston-Salem, NC 27105-1201  
In North Carolina Call: (910) 744-5050 or FAX (910) 744-5054

Visit us at IWCE/Spring, Booth #5043.

Circle (7) on Fast Fact Card



## More about intermodulation

By Harold Kinley, C.E.T.

Last month, we discussed third-order intercept and two-tone intermodulation testing using two equal-level, single-tone signals (A and B) to produce the intermod (IM) signal. Though two equal level tones (A and B) are used in third-order intermod testing of amplifiers and receivers, in the real world the mixing signals are rarely of equal level. In fact, one of the mixing signals usually has a much higher level than the other(s).

This discussion is limited to two-signal, third-order intermodulation. Though higher orders of intermod are often encountered, and more than two mixing signals can be involved, the third-order, two-signal IM is usually the most troublesome.

### Calculating IM level

The formulas in the box above can be used to determine how unequal-level tones (A and B) produce unequal IM signals,  $2A - B$  and  $2B - A$ . (The formulas also work for equal-level, two-tone signals). Furthermore, the power in the two IM signals can be determined from the power level of the two-tone mixing signals, A and B, and the third-order intercept point of the amplifier or other device under test (DUT).

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, Prentice-Hall, 1985. He is a member of the Radio Club of America.

### Formulas for calculating IM levels

$$P_{(2A-B)} = 2P_A + P_B - 2P_{I3}$$

$$P_{(2B-A)} = 2P_B + P_A - 2P_{I3}$$

where:  $P_{(2A-B)}$  = power level of IM signal in dBm

$P_{(2B-A)}$  = power level of IM signal in dBm

$P_A$  = power level of signal A in dBm

$P_B$  = power level of signal B in dBm

$P_{I3}$  = power level of third-order intercept in dBm

Figures 1 and 2 below show how two unequal tones, A and B, produce two unequal IM signals,  $2A - B$  and  $2B - A$ , at the output of an amplifier with a third-order intercept point of +30dBm. In Figure 1, tone A is at +10dBm, and tone B is at -10dBm. The  $2A - B$  IM signal is at -50dBm, whereas the  $2B - A$  IM signal is at -70dBm. Figure 2 shows a reverse of the levels of the two tones: A is at -10dBm, and B is at +10dBm. Notice how the two IM signals are reversed from Figure 1. From this comparison, we can see that the higher of the two IM signals,  $2A - B$  or  $2B - A$ , is always nearest the higher level tone, A or B.

### The graph

Figure 3 on page 79 is handy for calculating third-order IM levels when the levels of the two tones, A and B, are known. The graph is for an amplifier or other device with a third-order intercept point of +30dBm; however, it can be used for amplifiers with third-order intercept points other than +30dBm by applying an adjustment factor.

There are two horizontal scales at the top and bottom of the graph. The top horizontal scales are where the IM signal level is read. The bottom horizontal scales represent the level of the second-order term, A or B. For example, if the IM is formed from  $2A - B$ , then the term A is the *second-order* term, and the term B is the *first-order* term, and the resulting IM level found on the top horizontal scale would represent the  $2A - B$  IM signal level. Conversely, if the IM is formed from  $2B - A$ , then the B term is the *second-order* term, and the A term is the *first-order*, with the resulting IM level found at the top horizontal scale representing the  $2B - A$  IM level.

The *right* vertical scale of the graph represents the first-order term of the IM signal. The major divisions represent 10dB increments.

The *left* vertical scale of the graph can be used to adjust for third-order intercept points other than +30dBm. The

(continued on page 79)

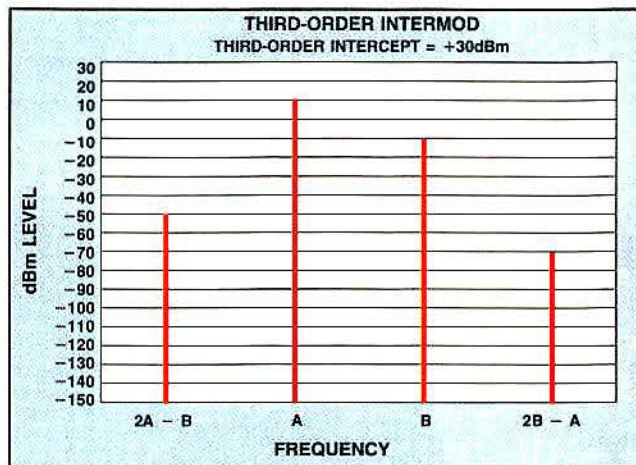


Figure 1. Signals A and B mix to form IM signals  $2A - B$  and  $2B - A$ . Note that the higher-amplitude IM signal is nearest to the higher-amplitude mixing signal, A.

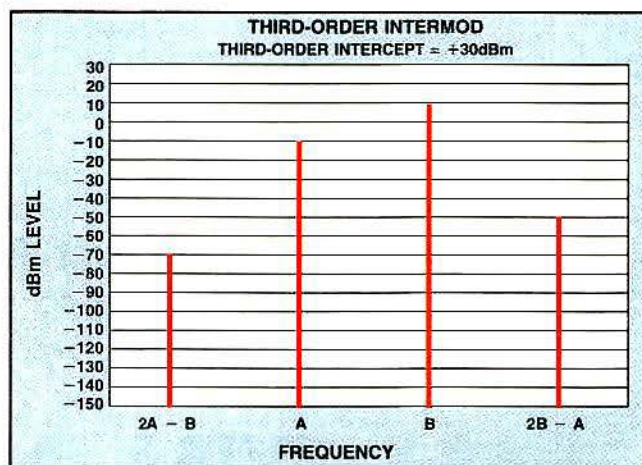


Figure 2. The mixing signals, A and B, are reversed from Figure 1. Now, the higher-amplitude mixing signal is B. Again, the higher-amplitude IM signal ( $2B - A$ ) is nearest to the higher amplitude mixing signal, B.



# Performance heard 'round the world.

Perfecting the quality of mobile communications is not a sideline at Centurion. It is a commitment that has earned the trust of countless customers around the globe. Durability. Mechanical integrity. A measurable standard of quality. These are just a few reasons why more people every day choose to communicate with Centurion antennas, batteries and battery packs. They perform as promised.

Competitive pricing. Timely deliveries. Engineering support. More reasons why Centurion is the talk of the industry, worldwide.

As communications technology continues to evolve, rest assured Centurion will be in the forefront, providing world class products for a global marketplace.

For the name of the Centurion distributor nearest you, call (800)-228-4563.



P.O. Box 82846  
Lincoln, Nebraska 68501  
(800)-228-4563/(402) 467-4491  
FAX (800) 848-3825/(402) 467-4528  
Circle (8) on Fast Fact Card



# Coaxial connectors: 7/16 DIN and type N

*Part 1—With the performance improvements required for digital communication applications, use of the 7/16 DIN connector is becoming increasingly widespread. It offers many technical advantages over the type N interface.*

By Jeffrey D. Paynter  
and Richard Smith

The 7/16 DIN connector is becoming more widely used in the United States, especially for today's demanding wireless two-way radio systems.<sup>1</sup> With the rapid evolution of wireless technology involving high transmit power levels and low

Paynter is senior design engineer, and Smith is manager, Connector Engineering, Andrew Corporation, Orland Park, IL.

receive noise thresholds, stringent requirements are increasingly being specified, especially regarding intermodulation (IM) performance. Coaxial radio frequency (RF) and microwave connectors, along with antennas and transmission lines, can be a source of intermodulation distortion in multichannel communication systems, although with proper design their effects can be minimized.

Operators and engineers must decide whether to use standard type N connector technology or to replace it with the 7/16 DIN interface in both new and existing installations. (See Photo 1 below.) The cor-

rect decision is important because an inappropriate selection could result in poor system performance, shorter service life or even component failure.

## Historical perspective

Germany developed the 7/16 DIN interface during the 1960s for high-performance military applications; it was later adopted for commercial applications in analog cellular systems. Its use expanded to other European nations, and in 1975 the International Electrotechnical Commission (IEC) adopted the specification. With the introduction of digital technology in cellular and mobile radio systems, in particular the Global System for Mobile Communication (GSM, formerly *Groupe Speciale Mobile*), increased effects of IM distortion were noticed. DIN-style connectors theoretically are superior for IM performance and thus became the interface of choice.

Today, 7/16 DIN connectors are widely used in GSM systems. They are installed throughout the base station and on antenna feeder lines, as well as in the radio equipment shelter. (See Photo 2 on page 11). Germany, as one would expect, is the largest user of the 7/16 DIN interface. Other European countries have been migrating rapidly toward the use of 7/16 DIN. For example, French Telecom recently chose 7/16 DIN connectors for its GSM base station installations.

In the United States, the type N interface has been widely used for many years.



Photo 1. A 7/16 DIN connector (left) and a type N connector. Tradeoffs must be considered in choosing which one to use in a particular installation.

1. "DIN" stands for Deutsche Industrie Normen (German Industrial Standard). DIN 47 223 specifies a high-frequency coaxial connector with a characteristic impedance of 50 $\Omega$ . "7/16" represents a nominal value of 16mm at the interface for the internal diameter of the external conductor, and a nominal value of 7mm for the external diameter of the internal conductor to achieve 50 $\Omega$ .



Though relatively new to the United States, use of the 7/16 DIN interface is on the rise. Both interfaces have advantages and disadvantages that must be considered in making an appropriate connector selection. How can one make the best decision? The following information is a concise technical comparison designed to simplify the decision process.

### Electrical performance

► **Intermodulation generation** — A leading cause of high bit-error rates in digital systems and unacceptable levels of noise in analog systems is a phenomenon known as *intermodulation generation*. In the United States, many large cellular carriers are testing for intermodulation generation in all passive components used in their digital cellular base stations. They have determined that replacing type N connectors with 7/16 DIN connectors reduces the level of IM generation. Radio original equipment manufacturers (OEMs) that have performed similar IM testing have claimed a measurable improvement using the 7/16 DIN connector. Cellular antenna manufacturers are beginning to convert antenna inputs on both panel and omnidirectional antennas to



Photo 2. The 7/16 DIN connector is widely used in European land mobile radio applications. Here, it is used to connect different sizes of cable.

7/16 DIN for the same reasons.

Intermodulation occurs in systems with multiple channels transmitted on the same media. In the presence of a non-linearity, any signal generates harmonics. When two signals are present, harmonics of both are produced. The harmonics of the two

signals can intermix, resulting in further spurious signals that are known as intermodulation products. The result of an intermodulation signal can be devastating to reception if it falls in a receive channel. As the number of signals increases, the probability of an intermodulation signal causing noise in a receive channel grows.

Magnetic materials, such as nickel and steel, are known to be a prime cause of intermodulation generation. These materials are inherently non-linear and should be carefully avoided on current-carrying conductors or in regions of RF field distribution. Even a stripe of nickel under a silver or gold plate has been implicated in unacceptable levels of intermodulation.

Electrical contact surfaces give rise to two additional non-linear effects: *Microscopic arcing* is caused by a small separation at the junction of electric conductors. *Electron tunneling* can occur when oxides form between contact surfaces. Together, these two effects represent the most challenging source of intermodulation in connectors.

The easiest way to minimize contact effects is simply to eliminate the junction, if possible. In a practical connector design, it is impossible to eliminate all contact surfaces; thus, further design techniques are used:

- high, even contact pressure.
- a distinct zone of contact.
- silver- or gold-plated contacts to prevent oxide buildup.
- soldered or brazed junctions where possible.

The greatest source of IM left in the connector is from the interface contact itself. The 7/16 DIN interface is superior to

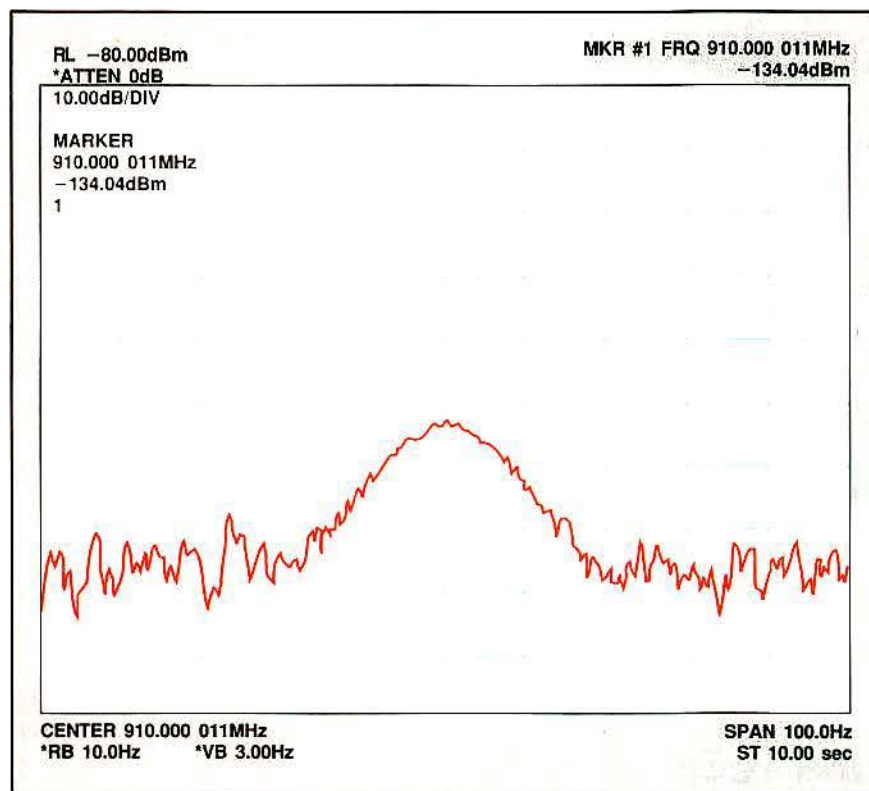


Figure 1. Intermodulation testing verifies whether steps taken to reduce intermodulation generation are effective in practice and under various conditions. A well-designed connector typically has IM levels of less than  $-125\text{dBm}$  with two  $+43\text{dBm}$  (20W) carrier signals. This graph shows an intermodulation product (IM) at 910MHz produced by two  $+43\text{dBm}$  carriers in an 18-inch cable assembly with a 7/16 DIN male connector. The third-order IM is  $-134\text{dBm}$ .



the type N regarding IM for several reasons. The coupling mechanism of the 7/16 DIN interface provides higher contact pressure. A special contact zone is provided at the tip of the inner contact, which ensures a reliable 360° contact; this full-circumference contact is not true with all type N connectors. The retractable coupling nut allows viewing of the inner contact mating to ensure that the conductors are properly engaged. The dimensions of

the 7/16 DIN allow for easy cleaning of the contact surfaces to remove dirt and oxide buildup. The larger conductors are more rugged and durable, which improves long-term reliability.

Even if all of the theoretical guidelines are followed, a connector may not perform as expected. It is critical that a connector designer have IM testing facilities to verify that the steps taken to reduce intermodulation generation are effective in

practice and under various conditions. A well-designed connector typically has IM levels of less than -125dBm with two +43dBm (20W) carrier signals. (See Figure 1 on page 11.)

As is a chain, a low-IM system is "only as strong as its weakest link." The connector design cannot solve IM problems entirely. For the lowest possible level of intermodulation products, use a cable with solid outer and inner conductors. In contrast, braided conductors are essentially a series of hundreds of sliding contact surfaces that can greatly increase the level of intermodulation generation.

► **Frequency** — The lower maximum frequency of the 7/16 DIN interface allows it to be better optimized but limits its application. In contrast, the type N is more versatile but typically has reduced performance. The maximum frequency, one of the fundamental differences between these interfaces, is a function of the dimensions and dielectric. An equation for calculating the maximum frequency,  $F_{max}$ , is:

$$F_{max} = 2(\text{Velocity})/\pi(B + A)$$

where

$$\text{Velocity} = c\sqrt{\epsilon}$$

A = inner conductor, outer diameter

B = outer conductor, inner diameter

c = speed of light in a vacuum

$\epsilon$  = dielectric constant

The standard type N interface dimensions are A = 0.276" and B = 0.120". With an air dielectric, those dimensions give  $F_{max} = 19\text{GHz}$ . In most connectors, an insulator is used to separate the conductors. With a common insulator, and allowing for a 10% safety factor, the maximum recommended frequency is reduced to 12GHz. This wide bandwidth allows the type N to be used in a wide variety of applications.

In contrast, the interface dimensions of the 7/16 DIN are A = 7mm and B = 16mm, resulting in  $F_{max} = 8.3\text{GHz}$ . A 7/16 DIN connector with a typical insulator has a recommended maximum frequency of 6GHz. This smaller bandwidth permits optimization of 7/16 DIN connectors for cellular, mobile radio and other lower-frequency applications.

*Next month: The 7/16 DIN connector's power handling capabilities and mechanical considerations.*

## THE SWITCH IS ON TO SONIC

Join the hundreds of dealers who have switched to Sonic for:

### **Favorable Pricing**

Call for quotes

### **Fast Delivery**

Same day shipping on many items

### **Outstanding Quality**

Compare our audio quality

### **Product Evaluation Program**

Call for details

### **Responsive Service**

Most repairs under 1 week

It all adds up to

### **Excellent Quality & Value**

### **Switch to Sonic today!**

# 800-688-1944

Call for your FREE 1995 Product Binder



## Sound Technology Working for You

Sonic Communications, Inc.  
4 Colonial Center, Box 287  
New Ipswich, NH 03071 USA  
Tel: 603-878-1944 • Fax: 603-878-1773

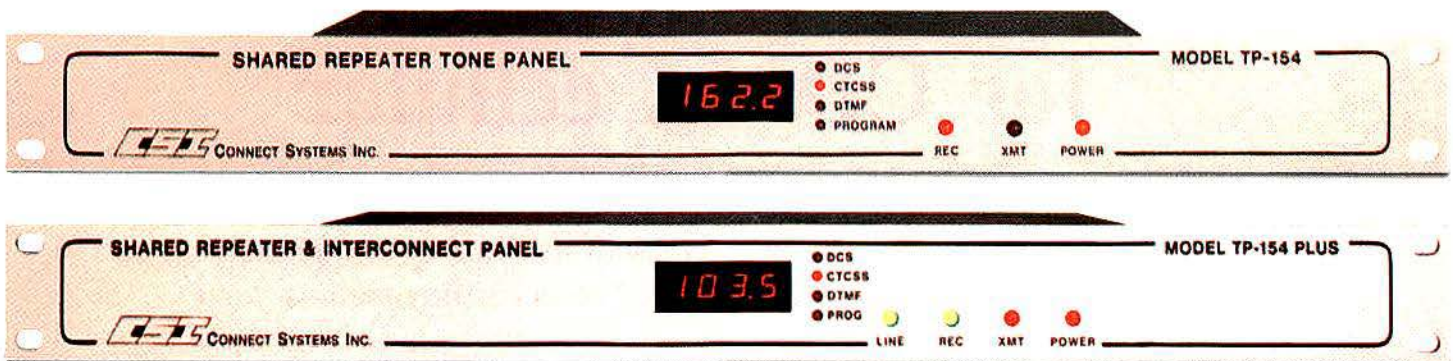


- A. Hi-noise environment headsets
- B. Lightweight headsets
- C. Ear microphones
- D. Motorcycle/Auto racing headsets

Circle (9) on Fast Fact Card



# Top Performance, Bottom Price!!



Unbeatable performance and pricing have made our **TP-154** the best selling Repeater Tone Panel ever offered. Our exclusive **CTCSS Trak™** and **CTCSS Hold Delay™** software leave the competition in **Z** dust!

Many customers asked us to add Interconnect to the **TP-154**. We have responded and now offer the **TP-154 PLUS!** There are many new innovations such as mobile commandable temporary cross tone. Below we've listed some of the more important standard features of this exciting new Repeater/Interconnect Panel...

## Repeater operation:

- 50 CTCSS tones
- 104 DCS codes
- Up to 154 repeater subscribers
- DTMF commandable temporary cross tone allows communicating with other CTCSS/DCS groups
- Mobile to mobile signalling
- Local, over the air and dial up programming
- Programming transpond to CD-1 Remote Data Display
- Data download to CD-1 Remote Data Display
- Front panel display
- CW ID per subscriber
- System CW ID
- Auxiliary Relay
- Repeater Time accumulation and Hits per tone/code

*And much more!*

## Interconnect operation:

- Up to 154 Interconnect subscribers
- Interconnect time accumulation per subscriber
- Ringout and/or Overdialing
- Land to mobile selective calling
- Two tone, 5/6 Tone, DTMF, CTCSS, DCS signalling
- Six unique ringing alerts allow selective calling within a CTCSS/DCS group
- Full or Half Duplex operation per subscriber
- DTMF commandable Half Duplex Privacy
- 1-7 digit Interconnect access code per subscriber
- Regenerated DTMF or Pulse dialout
- Busy signal and Dialtone disconnect
- Toll restricts (1, 0, 976, 9 etc.)
- Toll overrides (Allows dialing to specific exchanges within restricted area codes)

*And much more!*



Optional **EX-8 Line Expanders** bring private subscriber lines into the **TP-154 PLUS** and allow DID style operation for up to 64 subscribers. (No overdialing required). Subscribers are billed directly by the TELCO thus eliminating message accounting headaches for the system operator. Supplied rack or wall mountable.

Call Ray Dashner toll free at **800-545-1349** today for the complete story!

In Canada: Cartel 800-663-0070

Eastcom 800-263-2323



**Connect Systems Inc.**  
2259 Portola Rd.  
Ventura, CA. 93003

Phone (805) 642-7184  
FAX (805) 642-7271



# Test challenges for CDMA cellular

*A look at just a few of the required measurements for CDMA cellular telephones shows that some of the traditional methods of evaluating cellular radio performance are radically altered from existing methodologies.*

**Kenneth S. Thompson**

With the adoption of the IS-95 Air Interface standard by the Telecommunications Industry Association (TIA), code-division multiple-access (CDMA) technology has moved from mostly military use into the mainstream of public communications. Based largely on the CDMA system developed by Qualcomm, San Diego, the IS-95 standard provides an alternative digital cellular system. As an industry standard, IS-95 has attracted the attention of many subscriber and infrastructure equip-

Thompson is an engineer with Hewlett-Packard's Spokane Division, Liberty Lake, WA.

ment manufacturers. Many service providers, straining against the limits of the current advanced mobile phone service (AMPS) analog cellular system, have embraced CDMA technology as a means of providing high-quality service.

Until now, practical CDMA systems were not realizable in a form that would allow cost-effective cellular service. Today, it is feasible to use CDMA because of the high performance and relatively low cost of integrated circuits (ICs). The processing power of custom ICs, combined with advanced signal processing algorithms, translates into a cellular system that provides as much as 20 times the capacity of AMPS analog cellular.

CDMA provides additional benefits,

such as a reduced number of cell sites to provide equivalent coverage and data transmission capabilities. This new technology also brings new challenges for those who must design, produce, install and maintain a CDMA system. The nature of CDMA is such that the methodologies of traditional radio testing must be thrown out, and new ones must be learned. The following information describes some of the new challenges and requirements for testing subscriber equipment designed for the IS-95 CDMA cellular standard.

## CDMA system basics

The main concept behind direct-sequence spread-spectrum systems is to use unique digital codes to identify and spread a voice signal across a wide bandwidth. By spreading each user's signal with a unique code, it is possible to send many conversations using the same bandwidth and still be able to recover each conversation. (See Figure 1 to the left.)

CDMA begins by digitizing a voice signal into a low rate serial data stream. For IS-95, the data rate is 9,600 bits per second (bps) for active speech. Powerful error-correction codes are applied to this data stream that increase its rate to 19,200 bps. Increasing the data rate effectively "spreads" the occupied bandwidth of the signal. Pseudo-random codes then are used to further increase that data rate to 1.2288 million bps. The resulting spectrum of the final signal occupies 1.23MHz of bandwidth and appears as a block of random noise.

The spreading codes provide a unique marker for each telephone conversation. Careful design of these codes provides reduced or almost the theoretical minimum interference (orthogonal noise).

Upon transmission, a single user's signal is subjected to various interference sources. These include background noise in the 1.23MHz occupied spectrum, spurious interference signals and other users in

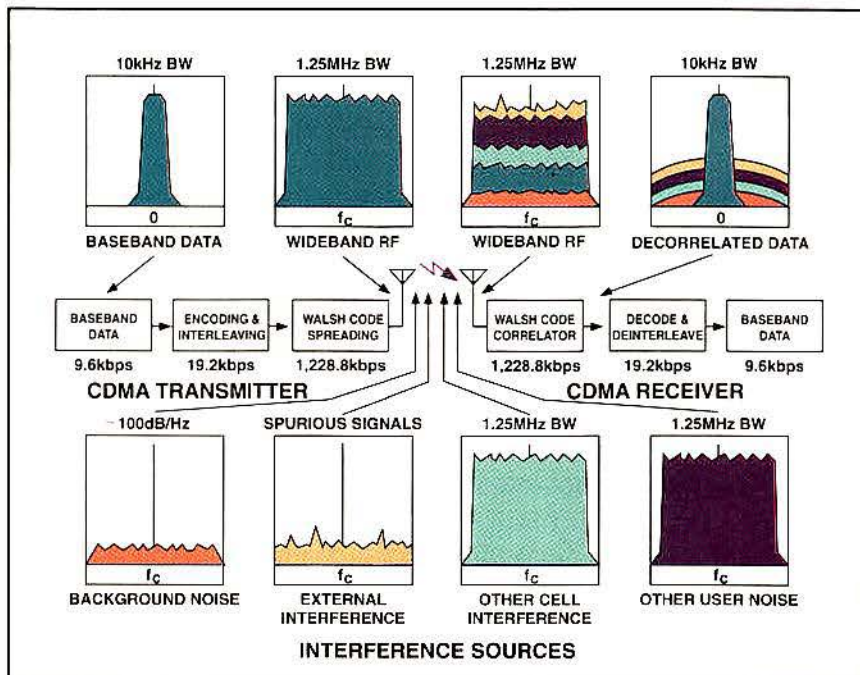


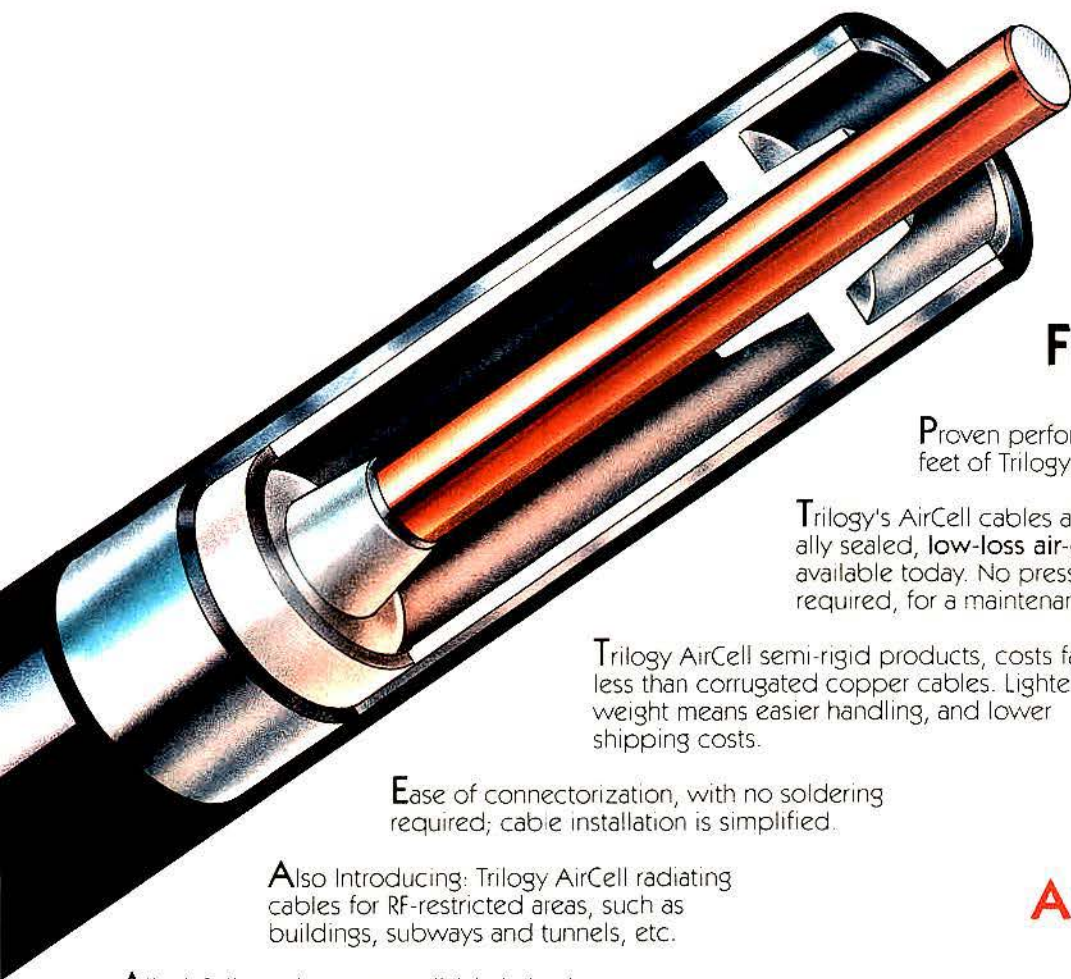
Figure 1. The fundamental concept of code-division multiple-access (CDMA) is to spread a narrowband signal with digital codes so that, upon reception, the desired signal can be recovered in the presence of large amounts of interference from other users.



# TRILOGY

C O M M U N I C A T I O N S

THE QUALITY ALTERNATIVE IN  
WIRELESS COMMUNICATIONS



**AIRCELL™**  
**TECHNOLOGY**

**Exclusively  
From Trilogy...**

Proven performance with over 1.5 billion feet of Trilogy products installed worldwide.

Trilogy's AirCell cables are the only hermetically sealed, low-loss air-dielectric cables available today. No pressurization is required, for a maintenance free system.

Trilogy AirCell semi-rigid products, costs far less than corrugated copper cables. Lighter weight means easier handling, and lower shipping costs.

Ease of connectorization, with no soldering required; cable installation is simplified.

Also Introducing: Trilogy AirCell radiating cables for RF-restricted areas, such as buildings, subways and tunnels, etc.

All AirCell products are available in both 50Ω and 75Ω.

**AIRCELL™ Family By  
Trilogy**

SENDING THE RIGHT SIGNAL



**Trilogy**   
COMMUNICATIONS INC.

Call or write for additional information:

TRILOGY COMMUNICATIONS INC., 2910 Highway 80 East, Pearl, Mississippi 39208  
(800) 874-5649, (601) 932-4461 / FAX (601) 939-6637

Circle (11) on Fast Fact Card



the same cell, as well as interference from users in adjacent cells. CDMA offers more capacity than narrowband systems because all users in every cell use the same RF spectrum. Narrowband systems must spread the available channels throughout the cellular network to preclude interference. AMPS cellular allows only  $\frac{1}{7}$  of the available channels to be used in any given cell. CDMA can reuse every channel in every cell because of the *processing gain*

derived from using codes to spread its signals. Processing gain is defined as:

$$\text{Processing gain} = 10 \log \left( \frac{\text{final signal data rate}}{\text{initial signal data rate}} \right)$$

For the IS-95 system, the processing gain is:

$$\begin{aligned} \text{Processing gain} &= 10 \log \left( \frac{1,228,800 \text{ bps}}{9,600 \text{ bps}} \right) \\ &= 21.07 \text{ dB} \end{aligned}$$

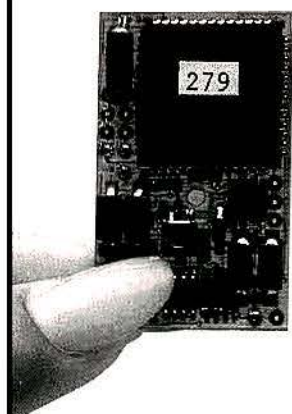
Thus, the available processing gain is about 21dB. Because CDMA only requires a signal-to-noise (S/N) ratio of 7dB for high-quality reception, this leaves 14dB of available gain. This extra gain allows a CDMA receiver to recover a signal that has a -14dB signal-to-noise ratio!

Referring again to Figure 1, at the CDMA receiver, the total noise of all the users on the same frequency is combined with the desired voice channel. The wanted voice channel presents a negative S/N ratio to the receiver. By correlating to the desired code, the receiver can recover the desired channel even though it is buried in the noise.

The Walsh codes used to encode each voice channel produce interfering noise that is orthogonal to all other encoded voice channels. When a CDMA mobile station's receiver correlation circuit tries to decode its unique signal from the base station, all other interfering channels produce a nearly zero correlation product. (This is the definition of orthogonality.) Even so, when the correlator locks to the code it is searching for, the correlation product is extremely large.

Another way to think of this is that the transmitted CDMA signal is largely redundant. The codes used to spread the voice channel allow for large errors to occur over-the-air without degrading the quality of service. Unlike existing narrowband cellular systems, the IS-95 CDMA system thrives in the presence of interference. At the same time, the robustness of the air interface in CDMA leads to some highly different types of measurement requirements.

## Caller ID. It will stop the mikers.



### Digital ANI

Caller ID will end the stuck mikes and stop the horseplay on your radios. ID-33 includes time-out timer and emergency. Fleet prices \$69 to \$121. 800-521-2203.



**CSC CONTROL SIGNAL**

1985 S. Depew, #7, Denver, CO 80227  
(303) 989-8000

Circle (12) on Fast Fact Card

# WACOM

## QUALITY • SERVICE • PRICE

### ...WE DO IT BETTER!

FOR THE 150, 450, & 850 MHz BANDS

- Low-loss Transmitter Combiners
- Receiver Multicoupler Systems
- Coaxial Cavity Filters
- Duplexers

*Investigate this complete line of high performance products today!*

PHONE 817-848-4435  
FAX 817-848-4209

# WACOM

PRODUCTS, INC.

P.O. BOX 21145 • WACO, TEXAS 76702



Circle (13) on Fast Fact Card

### Subscriber unit transmitter tests

► *Modulation quality* — IS-95 standard subscriber units (phones) use *offset quadrature phase-shift keying* (OQPSK) modulation to transmit digital information to CDMA base stations. The accepted figure of merit for the quality of an OQPSK modulated transmission from a mobile is called *rho* ( $\rho$ ).

The  $\rho$  measurement also is referred to as the *power correlation coefficient*. The concept of the  $\rho$  measurement is fairly simple. Although the CDMA system is designed to operate with high levels of interference, the ultimate capacity of any given cell is limited by the total interference. As the number of users increases, so does the total interference level. At some point, the interference prevents the processing gain from recovering a transmitted signal.

For cells that are equally loaded, this limit is about 32 callers per cell or sector. If any mobile station's transmitter is not properly encoding each user's data into the



# The New STABILOCK® 4015 Radio Test Set Tests Great – Less Weight.

Finally, a two-way radio tester that fits under a helicopter seat, weighs less than 20 lbs., provides all the capabilities you've dreamed of in one unit, and doesn't cost an arm and a leg.

The STABILOCK 4015 packs a lot of features in a compact design:

- spectrum analyzer with audio
- electroluminescent display for easy viewing night or day
- licensed CLEAR CHANNEL LTR® testing capability
- memory cards to load and run tests automatically, including all cellular formats
- digital storage oscilloscope
- internal battery

Lighten your two-way test load today – call for more information on the STABILOCK 4015:

**1-800-392-8100 (in MA: 617-229-7585).**

CLEAR CHANNEL LTR is a registered trademark of the EF Johnson Company. STABILOCK 4015 is a registered trademark of Wavetek Corporation.



Wavetek Corporation  
128 Wheeler Road  
Burlington, MA 01803  
Phone-617-229-7585  
Fax-617-273-5943

**WAVETEK**



required code, some of the transmitted power will appear as increased noise to other users. The  $\rho$  measurement computes the power of a CDMA transmitted signal that correlates to the desired code. Thus  $\rho$  gives an indication of the increased interference that will be caused by modulation errors in a CDMA transmitter.

A  $\rho$  value of 1.00 indicates that all of the transmitted power correlates with the ideal transmission code. The specified performance level that a CDMA mobile must meet is 0.944, indicating that 94.4% of the transmitted energy correctly correlates into the ideal code. At this level of  $\rho$  performance, the increased noise to other users caused by a CDMA transmitter will be an additional 0.25dB.

The  $\rho$  measurement is performed by downconverting a CDMA-modulated signal to an IF low enough to allow the waveform to be digitized. The digitized signal then can be analyzed by a digital signal processor (DSP). The definition of  $\rho$  is given in the PN-3121 mobile test specification currently out for balloting by members of the TIA (that will become the IS-98 standard).

Two other important mobile station characteristics derived from the  $\rho$  mea-

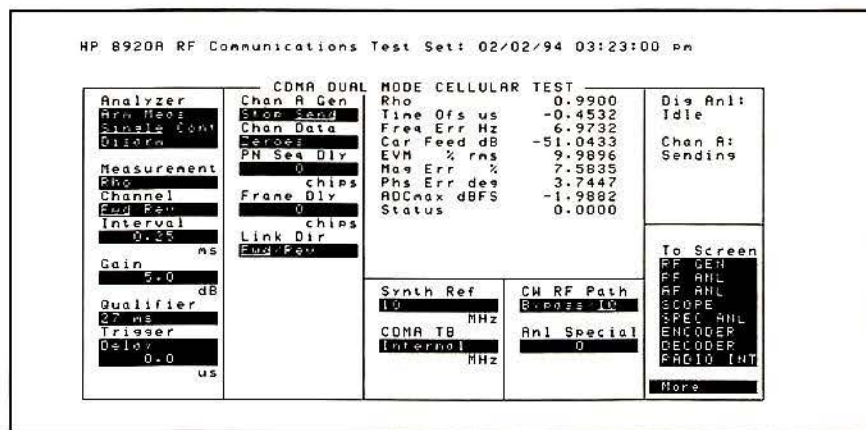


Figure 2. The  $\rho$  measurement is required to report static time offset and frequency error, I/Q origin offset and error vector magnitude. As an option, amplitude and phase errors can be provided.

surement are *transmitted frequency error* and *static time alignment*. (See Figure 2 above.) Because the transmitted CDMA waveform is spread using pseudo-random codes, the resulting RF waveform appears as a block of random noise. A conventional frequency counter cannot accurately measure the center frequency of an OQPSK modulated signal. The value of the frequency error used to maximize the measured value of  $\rho$  provides the esti-

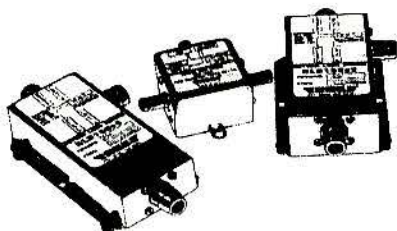
mate of the carrier frequency error.

In a similar manner, during the calculation of  $\rho$ , the DSP must derive an estimate for the static time offset. This is a measure of how accurately the CDMA mobile has aligned its timing to the reference signal broadcast by a CDMA base station. Any test equipment that measures mobile station  $\rho$  therefore must provide an RF signal emulating the pilot channel transmission of a CDMA base station. The specified performance levels for a CDMA mobile are  $\pm 300$ Hz of frequency error and time alignment within  $\pm 1\mu$ s.

Some of the mechanisms that can contribute to errors in  $\rho$  include in-phase quadrature (I/Q) modulator offsets, I/Q modulator gain imbalance, amplifier distortion and filter errors. Dc offsets present in the I/Q modulator circuitry cause the I/Q pattern of the modulation to shift away from being centered at the origin. Figure 3 below shows an OQPSK-modulated signal's I/Q diagram that contains significant dc offsets.

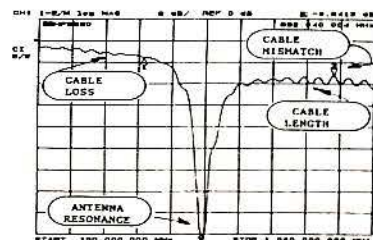
Because of the shifting away from the origin, I/Q dc offset sometimes is referred to as I/Q origin offset. Ideally, an I/Q-

## EASY ANTENNA & TRANSMISSION LINE MEASUREMENTS



Return loss bridges from Eagle cover from .04 MHz to 3.0 GHz. These are self contained units that require no attenuators, amplifiers or detectors. All the additional equipment is contained in your service monitor or spectrum analyzer. Five watt power rating, unmatched in the industry, protects YOUR bridge from power coming from the antenna at crowded sites. Rugged nickel plated brass enclosures assure excellent durability and shielding.

Tired of not knowing where your antenna stands? Wattmeters that test one frequency or antenna testers that are disturbed by outside signals at the antenna are not the answer. Most of the answer is on your bench. Adding an EAGLE return loss bridge to your service monitor makes a complete antenna measurement system.



Free: Application note, "Antenna and Feedline measurement", call and ask for it! The following EAGLE products will also aid in testing: Precision coaxial cable jumpers, power dividers, and reference Terminations. Eagle RLB150 series bridges start at \$259.00.

# EAGLE

VOICE: (520) 204-2597  
FAX: (520) 204-2568  
P O Box 4010 Sedona, AZ,  
86340

Circle (93) on Fast Fact Card

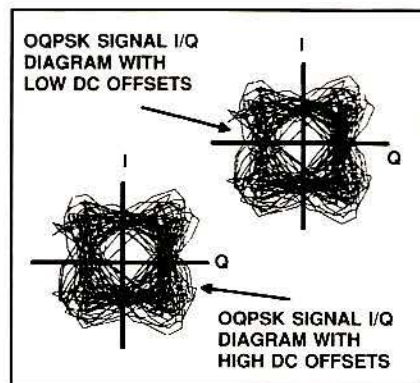


Figure 3. Ideal and I/Q offset I/Q diagrams for an OQPSK-modulated carrier used by CDMA mobiles.



# HELIAX®

## *A Cut Above Braided Cable*

Today's sophisticated communications systems demand a higher level of performance that braided cable and connectors aren't cut out for.

Now more than ever, it's essential that you "Ask for HELIAX" coaxial cable and connectors. Electrically and mechanically superior to braided cables, HELIAX coaxial cable is specifically designed to handle today's higher frequencies, multi-channels and higher average power levels.

When fabricated with Andrew premium performance connectors, HELIAX coaxial cable assemblies optimize electrical and mechanical performance, protecting against EMI-RMI interference and intermodulation. And HELIAX coaxial cable is highly flexible, weatherproof and durable.

Highly flexible,  
shape holding solid  
copper conductor

Closed-cell foam-dielectric  
ensures low loss

New easy to attach connectors  
deliver superior mechanical  
integrity

Premium platings minimize  
intermodulation



**ANDREW**

10500 W. 153rd Street  
Orland Park, IL 60462 U.S.A.

For complete details, call our Customer Support Center  
at 1-800-255-1479 Ext. 13, or fax us at 1-800-349-5444.

*HELIAX® Cable... The Global Leader in Cellular Communications*

Circle (16) on Fast Fact Card



HP 8920A RF Communications Test Set: 02/02/94 03:26:00 pm

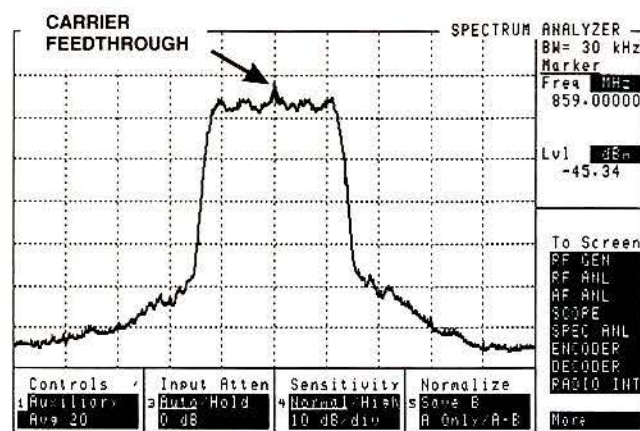


Figure 4. A 1.23MHz-wide CDMA signal with excessive carrier feedthrough.

modulated signal will not allow any of the carrier to leak through to the output. In the frequency domain, I/Q offsets result in the carrier not being suppressed. Figure 4 above displays a spectrum analyzer plot of an OQPSK modulated signal that has high carrier feedthrough (significant I/Q dc offsets). Figure 4 shows the carrier is

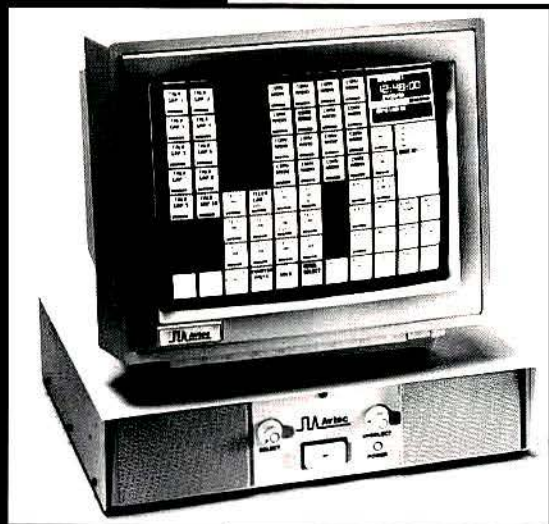
protruding above the OQPSK modulation. Carrier feedthrough (origin offset) is an important modulation quality measurement in CDMA because it can be a significant component of the  $p$  error. The DSP algorithms used to compute  $p$  can determine the carrier feedthrough from the same digitized time record of the

transmitted waveform. I/Q offset error can be expressed in terms of normalized I/Q values, but it is more commonly converted to a carrier feedthrough form expressed in dBc. For example, a 1% I/Q imbalance error translates to a carrier feedthrough level of -20dBc (dB below the unmodulated carrier level).

Gain imbalances in the I/Q modulator also cause problems with  $p$ . If the gain is not precisely matched between the I and Q channels, the resulting modulated waveform will display distortion. Figure 5 on page 22 shows the effect on the I/Q diagram for an OQPSK-modulated waveform where the Q channel gain is less than the I channel gain. The resulting distortion moves the symbol decision points away from the ideal position in toward the I axis. This type of signal distortion increases the  $p$  of the transmitted signal.

The IS-95 system also specifies the type of lowpass filtering that must be applied to the I and Q channels before modulation. If the filter introduces errors, the I/Q pattern produced will not match the ideal trajectory. Both errors in amplitude and phase from filter error will increase  $p$  and thereby increase the

## DSPatch—THE WORLD'S MOST ADVANCED DIGITAL SWITCH FOR VOICE COMMUNICATIONS



architecture ensures instant responses, even in large systems. DSPatch may be configured to support from 32 to 1,024 external lines or operator workstations.

Utilities, airlines, railroads, public-safety, military and other government agencies worldwide have come to rely on Avtec for advanced, high-capacity console solutions for integrated radio/telephone systems. DSPatch is a color touchscreen console system that employs Digital Signal Processors (DSP's) at every line and workstation. Its distributed

### FEATURES INCLUDE:

- ◆ User configurable screens
- ◆ Conventional or trunked radio
- ◆ ANI with call queue
- ◆ Multi-format paging
- ◆ Simultaneous conferences
- ◆ Many more

*DSPatch32, a 32-port system, is available for smaller applications.*

*Call, fax or write for additional information or a budgetary proposal.*

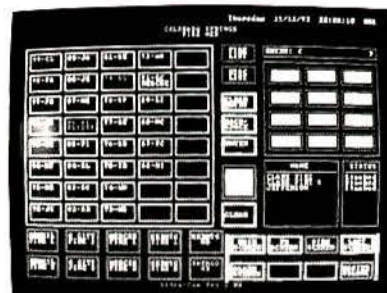
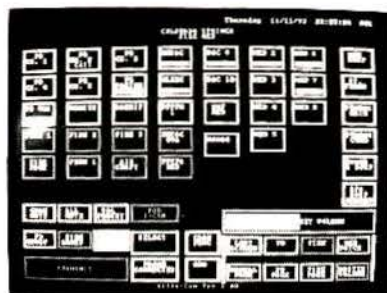
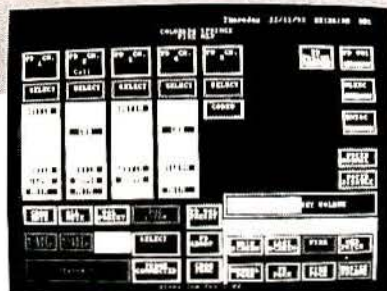
**Avtec**

4335 Augusta Highway  
 Gilbert, SC 29054 USA  
 Phone: (803) 892-2181  
 FAX: (803) 892-3715

Circle (17) on Fast Fact Card



# There's more than one reason why MODUCOM Dispatch Consoles are First Choice



Only the Ultra-Com PRO communications workstation lets you design screens for *your* specific requirements, with no changes to software in the common electronics.

- Exclusive "Screenmaker" feature lets user design screen's operational requirements
- Exclusive "Customizer" feature allows more programmability
- Free software upgrades
- Intel 486 operator-interface (Pentium PC optional)
- Hardware upgrade without firmware changes
- Moducom system design and specification assistance
- Support when you need it

## They're talking about us . . .

- ☐ "For real value, high tech and support, we found that Moducom was hard to beat."  
*Steve Meer, V.P. Systems Integration, SCC Communications, Inc.*
- ☐ "Modular Communications proved to us that they have the real handle on state-of-the-art."  
*Bill Smith, Dir. of Communications, Wyoming Highway Patrol*
- ☐ "We have a number of Ultra-Com PRO touchscreen consoles and they have proven to be extremely reliable."  
*Mike Slavick, Communications Div., Larimer County, CO*

Call, write or fax for our Ultra-Com PRO literature package

## MODULAR COMMUNICATION SYSTEMS, INC.

13309 Saticoy St., No. Hollywood, CA 91605 • (818) 764-1333 • FAX: (818) 764-1992  
Texas Office: 211 King Nicholas, Scroggins, TX 75480 • (903) 860-3660 • FAX: (903) 860-3658



interference level to other CDMA users.

#### Power measurements

IS-95 standard CDMA uses two types of power control to keep the mobile station's output power to the absolute minimum necessary to maintain a quality link. By keeping the transmitted power low, interference to other users is reduced, and the maximum capacity of the system is maintained. Low power also translates to longer

talk time for hand-held mobiles. The dynamic nature of CDMA power control lessens the importance of absolute power measurements so common in traditional cellular phone testing. The most important absolute power measurement in CDMA verifies the maximum output power. The maximum output power test is mandated by regulatory requirements.

The first type of power control in CDMA is called *open loop power control*.

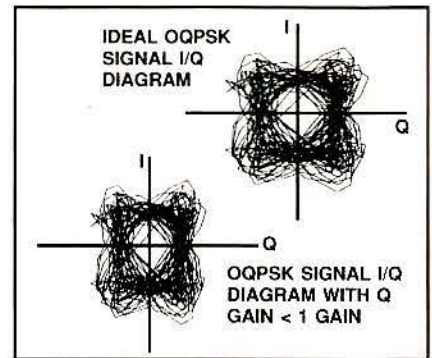


Figure 5. The effects of I/Q gain imbalance on an OQPSK-modulated signal.

Open loop power control is so named because it is performed by the CDMA mobile without feedback from the base station. Open loop power control causes a CDMA mobile to monitor the received power from the base station and continuously adjust its output power accordingly. Ideally, the mobile must raise or lower its output power linearly for every change in the received power from the base station. Open loop power control follows this equation with the powers in terms of dBm:

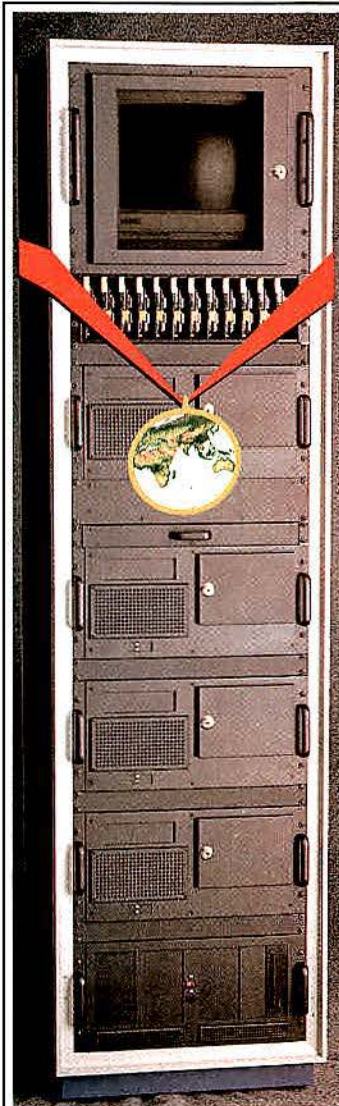
mobile transmitted power =  $-73 - \text{received base station power}$

For example, if the CDMA mobile receives a base station signal at  $-73\text{dBm}$ , it sets its output power to  $0\text{dBm}$ . In this manner, the CDMA mobile uses the strength of the base station's signal as an indication of the current propagation conditions.

To measure the accuracy with which a CDMA mobile performs open loop power control, a mobile first must be actively transmitting and monitoring the signal level from a source simulating at least a CDMA base station pilot channel. By then changing the output level of the simulated pilot channel and then measuring the response of the CDMA mobile, the open loop power control performance of the mobile can be verified.

For example, if the pilot channel signal strength is increased by  $10\text{dB}$ , the mobile's transmitted power should decrease by  $10\text{dB}$ . By specification, the CDMA mobile must follow the open loop power control equation with  $\pm 9.5\text{dB}$  accuracy throughout an  $80\text{dB}$  dynamic range.

The second method used to control output power in the IS-95 system is closed loop power control. Closed loop power control is controlled by the base station rather than the mobile station. In the IS-95 system, the base station measures the amplitude of the mobile's received signal 800 times per second. Based on the received level, the base station commands



## PRISM II Paging Systems by TGA are WORLD CLASS

TGA PRISM II paging systems are designed to meet the standards used by international telephone administrations such as:

- E1 PCM telephone trunking
- MFCR2 telephone signaling
- "Click detection" of decadic telephone input
- Built-in PCM voice storage
- Multi-lingual caller prompts
- Modular expansion for city-wide or nation-wide operation
- Internal ACD for operator dispatch of alphanumeric messages
- Special versions of POCSAG for international character sets
- FLEX™ for future system compatibility
- Continuous Batch™ digital paging
- Multiple Intel 486™ DX2/66 processors



To learn more call:  
**+1-404-441-2100**  
**FAX 404-449-7740**

TGA Systems, Inc.  
Suite 150  
3100 Medlock Bridge Road  
Norcross, GA USA 30071-1429

The Intel Inside logo is a registered trademark of Intel Corporation. FLEX is a trademark of Motorola, Inc.

**TGA**  
Systems, Inc.

**PRISM**

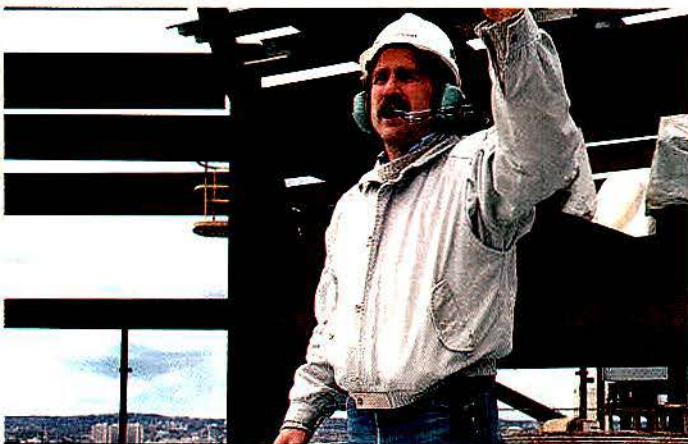
Circle (19) on Fast Fact Card



# APPLICATIONS FOR NOISE-ATTENUATING HEADSETS



David Clark Company's VOX (voice-activated) System allows crane operators to keep both hands free to work the controls. They hear instructions the first time, avoiding costly errors.



A foreman's job depends on clear communication. Noise-Attenuating Headsets, with noise-canceling microphones, allows use of the radio, regardless of background noise.



The safety of many people depends on the pump operator's ability to hear and transmit messages clearly. David Clark Headsets make this possible.



The constant noise of the locomotive makes it very difficult to transmit and receive on the radio. Noise-Attenuating Headsets offer the perfect solution, combining hearing protection with clear communication.

For durability and reliability, David Clark Company **Noise-Attenuating Headsets** are the clear choice, regardless of your application. All headsets are tested and certified with a Noise Reduction Rating (NRR-24dB), as mandated by the EPA, and are backed by the best customer-service policy in the industry.

Headsets and adapters are available for all types of two-way radios, including:

- PTT (push-to-talk, with boom microphone)
- VOX (voice-activated, with boom microphone)
- VOX-TM (voice-activated, with throat microphone)

Also available: the Series 3800 Intercom System with mobile radio interface.

For all these reasons and more, call or write for complete information.



**David Clark** COMPANY  
INCORPORATED

360 Franklin Street, P.O. Box 15054, Worcester, MA 01615-0054  
TEL: (508) 756-6216; FAX: (508) 753-5827; TELEX: 920482

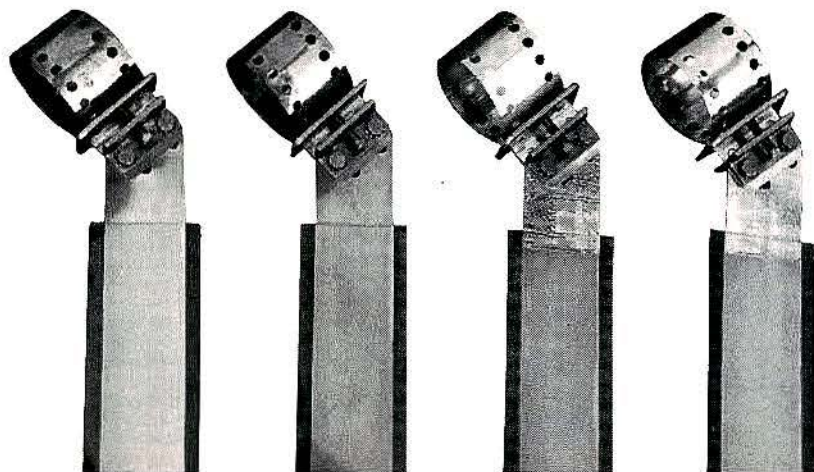
Circle (20) on Fast Fact Card

©1990 David Clark Company

Visit us at IWCE/Spring, Booth #3068.



# New Unique Cable Grounding Kit Series



## Uni-Kit 2 Series

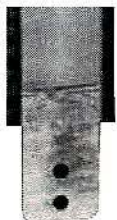
- ▶ Fits cables up to 2" (down to 1/4")
- ▶ Fits elliptical waveguides
- ▶ Lower resistance (less than half others)
- ▶ Lower inductance (almost half others)
- ▶ Vibration and wind tested
- ▶ Quick nut driver installation
- ▶ Adjustable strap to cable angle
- ▶ Four models for no dissimilar connections
- ▶ Competitively priced



**Uni-Kit 2CT**  
Copper coax  
to Tower



**Uni-Kit 2CC**  
Copper coax  
to Copper



**Uni-Kit 2TT**  
Tinned coax\*  
to Tower



**Uni-Kit 2TC**  
Tinned coax\*  
to Copper

\* Can also be used for grounding a galvanized tower leg.

**PolyPhaser**  
CORPORATION

(800) 325-7170 ■ (702) 782-2511 ■ FAX: (702) 782-4476  
2225 Park Place ■ P.O. Box 9000 ■ Minden, NV 89423-9000

Circle (21) on Fast Fact Card

the mobile to increase or decrease its output power by 1dB every 1.25ms (800 times per second).

Closed loop power control allows the base station to fine tune the received signal level from the mobile. This provides for the best voice quality with the absolute minimum transmitted power. The standard method of testing closed loop power performance involves verifying the overall range and linearity of the mobile's closed loop power control range. A CDMA mobile station must demonstrate a  $\pm 24$ dB closed loop power dynamic range as well as have a well-defined slew rate as it changes power.

To verify performance, the test equipment first must establish a call with the

*Corrupted frames in  
CDMA are not  
retransmitted, and the  
voice decoder must  
either interpolate the  
missing data or mute the  
audio output.*

CDMA mobile, then command the mobile to increase its power by more than 24dB, and then measure that the mobile has increased power at least 24dB. Then the mobile must be commanded to lower its power by at least 24dB, and it must be verified that it meets the standard.

### Mobile station receiver tests

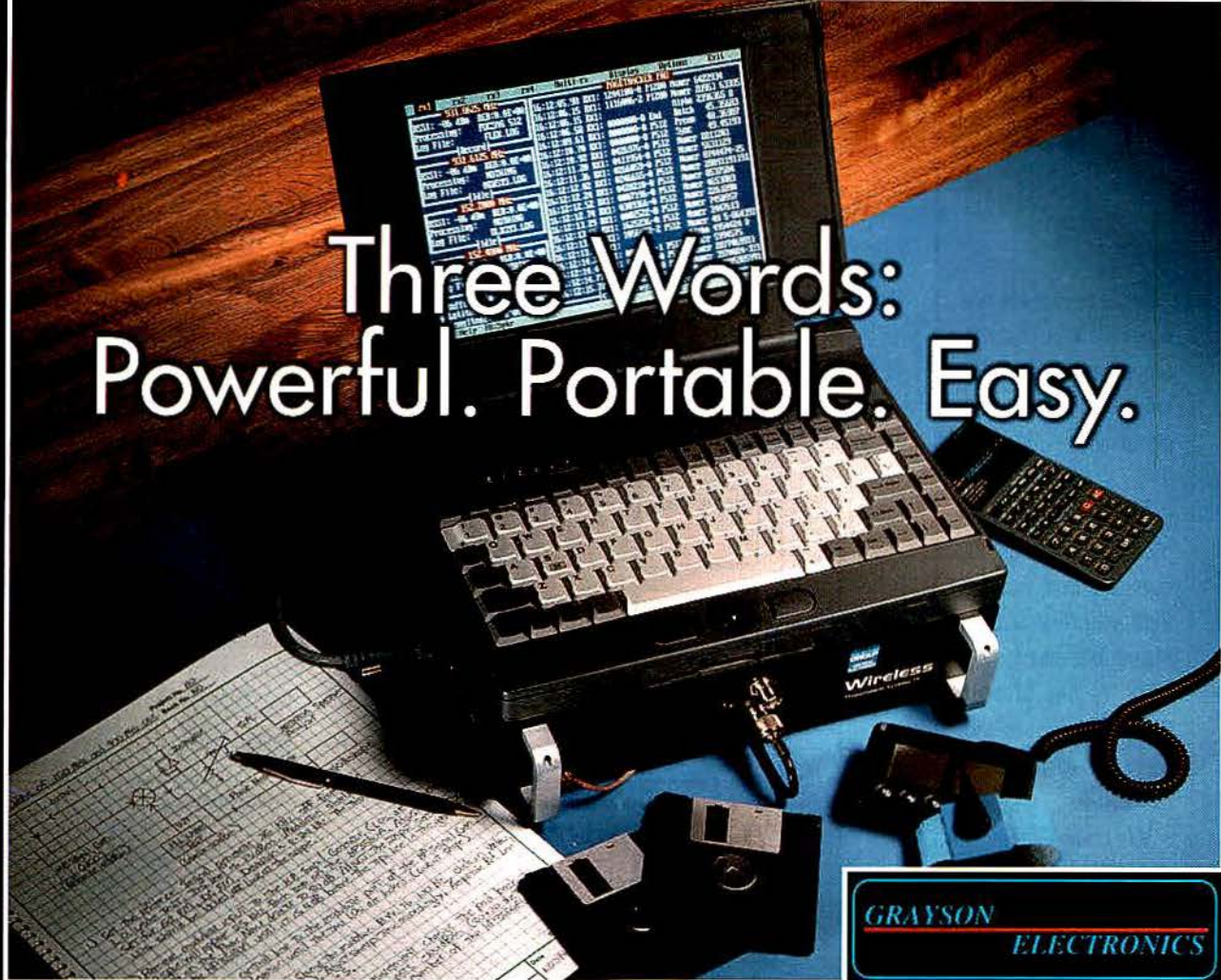
Because of the processing gain of the CDMA system (redundancy in the transmitted waveform), individual bit errors in the received waveform are of little consequence. The codes used to increase the digitized voice signal's bandwidth provide powerful error correction. Bit errors on the physically received signal are easily repaired by the error-correcting action of these codes.

Because of this corrective action, the traditional test of digital receiver performance—bit-error rate—is not useful in CDMA applications. A more meaningful test for CDMA is *frame-error rate* (FER). FER is the true measure of CDMA receiver performance because it indicates the number of frames that have been so corrupted that the error correction cannot fix them.

Each CDMA frame contains the digitized voice bits for 20ms of speech. Corrupted frames in CDMA are not retrans-



# Three Words: Powerful. Portable. Easy.



## One Tool: PAGETRACKER Pro™, The Paging Industry's New Standard in Wireless Measurement Instruments.

You want one instrument for all your network test and analysis needs. Your customers want quality paging service. Revolutionary PAGETRACKER Pro is the answer.

Advanced PAGETRACKER Pro packs a range of features and measurement capabilities never before available in a single, easy-to-use piece of test equipment. It reads all paging activity — including FLEX — in real time so you can see what's actually going out over the air instantly. Four easily tunable, independent receivers let you take up to four different measurements on a single channel, or the same measurement on up to four different channels. High-performance, ultra-stable receivers provide reliable, accurate measurements.



At under 10 pounds, PAGETRACKER Pro is a powerful, portable WMI that decodes all POCSAG, NEC, GOLAY, and FLEX paging signals virtually anywhere in your coverage area.

You can simultaneously measure signal strength, BER, traffic, interference and more, with comprehensive measurement capabilities like throughput, traffic statistics and batch efficiency. A NAVTRACKER GPS receiver provides multiple test results with position stamps to dramatically improve your troubleshooting. PROMAP® software automatically plots those results as a color map for a virtual blueprint of your system's strengths and weaknesses.

One tool. One company. One call. Contact Grayson Electronics today at 1-800-800-7465 to find out how PAGETRACKER Pro can help solve potential system problems before they become problems for your customers.



306 Enterprise Drive  
Forest, VA 24551  
FAX 804-385-7692

PAGETRACKER Pro is a trademark and PROMAP is a registered trademark of Allen Telecom Group Inc.

Your Wireless Connection.

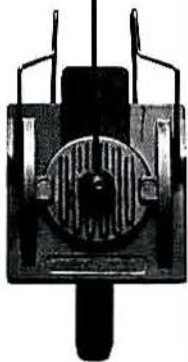


# ANTENNAS

Whether your antenna needs are large or small, our extensive product range will increase your signal range.

Our innovative line of products offers unique solutions: from our new **5 dB gain Roof or Body Mount Antennas** for 220 MHz, to our **Clip-On Portable Antennas** with easy car-to-car portability.

We cover all frequencies, from HF up to 2.5 GHz. And, we offer a wide range of antennas: roof or body mounts, glass mounts, portable phone antennas, base station antennas.



*Give us a call,  
or send a fax.  
We'll be happy  
to send further  
details.*

## MOBILE MARK® COMMUNICATIONS ANTENNAS

US OFFICE:  
Tel: +1-708-671-6690  
Toll-free in US: 1-800-648-2800  
Fax: +1-708-671-6715

UK OFFICE:  
Tel: +44-543-878343  
Fax: +44-543-871714

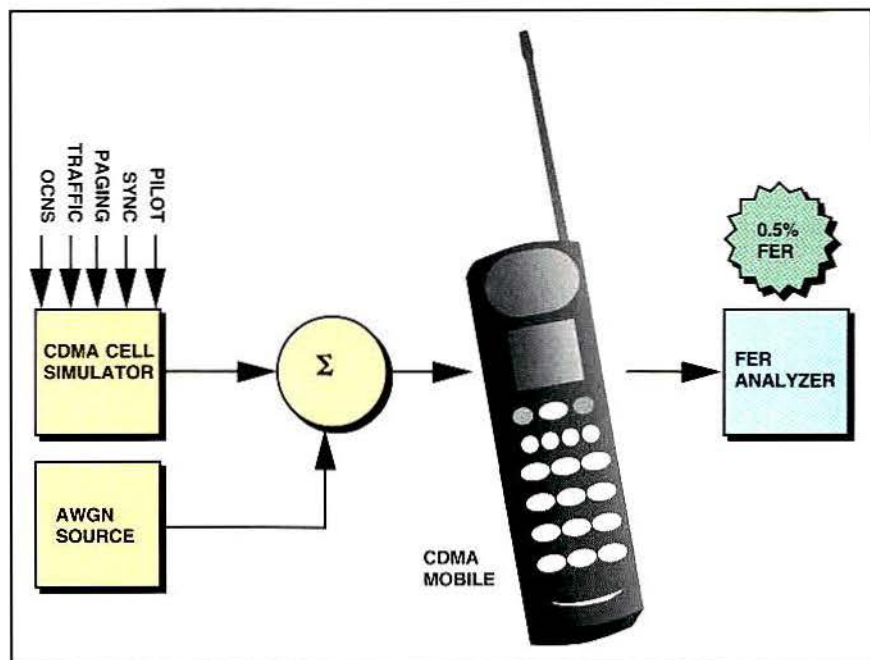


Figure 6. A measurement block diagram for the FER-with-AWGN receiver test.

mitted, and the voice decoder must either interpolate the missing data or mute the audio output. The acceptable level of FER for weak signal conditions is about 3%. This performance level still produces acceptable speech quality.

An FER test is made by sending a CDMA base station voice channel signal to a mobile in a special mode called Service Option 2. Service Option 2 places a CDMA mobile into an operational mode called *data loopback mode*. This special mode is required for all mobiles that comply with the IS-95 air interface standard. In data loopback mode, the CDMA mobile retransmits the data it receives from the base station without modification. Service Option 2 allows an accurate FER measurement to be made.

Test equipment designed to make FER measurements can command the CDMA mobile into Service Option 2, then send the mobile a known data pattern, and, upon reception, calculate the FER. The simplest FER test involves testing a mobile without any interfering signals (receiver sensitivity and dynamic range test). This type of test corresponds to the traditional sensitivity test using SINAD as the figure of merit for an AMPS phone.

A sensitivity test is not necessarily applicable to real-world performance for a CDMA phone because, under normal conditions, a CDMA phone is not operating without interference. A more realistic test for CDMA phones is FER performance in the presence of significant interference. (See Figure 6 above.) This test for CDMA is

called FER-with-AWGN (additive white Gaussian noise) and is roughly equivalent to a selectivity test for AMPS phones. This noise signal must be at least 1.8MHz in bandwidth and is used to simulate the interference of users in adjacent cells. This test also calls for a signal to simulate the interference of users inside the same cell (orthogonal channel noise source, or OCNS).

When combined at the proper levels, AWGN, OCNS and the desired voice channel are sent to the mobile under test to determine the receiver's ability to properly demodulate the voice channel. Note that for traditional cellular phones, a selectivity test measures the receiver's ability to reject a signal in the next adjacent channel (frequency). For CDMA, the FER-with-AWGN test also is a measure of the receiver's ability to reject another channel, but in the CDMA case, the other channel is using a different code on the same frequency.

### Conclusions

Looking at just a few of the required measurements for CDMA cellular telephones shows that some of the traditional methods of evaluating cellular radio performance are radically altered from existing methodologies. The challenge for the cellular industry is to raise its technical understanding and expertise on CDMA test issues to successfully roll out this new technology. In addition, test equipment vendors will need to develop a new generation of test equipment designed to handle the rigors of CDMA testing.



*Eagle Telecom International...*  
*...Defining The New Frontier For Power Amplifiers!*



Most power amplifiers in today's telecommunications market rely on circuit board materials incapable of handling the typical thermal stress found in most paging, SMR and cellular applications. In addition, typical applications require the power transistors to operate beyond their rated specifications.

Eagle Telecom International's new leading edge line of SMR, cellular and paging power amplifiers are now setting the standards for the whole industry. Eagle power amplifiers are designed with space age technology that allows sustained high power output in extreme conditions while operating at lower temperatures. Eagle's design dissipates heat by utilizing new high dielectric thermally conductive circuit board material that was originally intended for earth orbiting satellites. New high power transistor technology gives Eagle power amplifiers high power stamina, while operating well below the tested specifications.

Stop relying on yesterday's power amplifiers; thrust your system into the "New Frontier" by investing in Eagle Telecom's power amplifiers. They are truly "Out Of This World" in more ways than one!



*Eagle Telecom  
International*

**1-800-628-3910**

(713) 280-0488  
Fax: (713) 280-0381

Manufactured in Houston, TX, USA

**Circle (24) on Fast Fact Card**



---

# Pulling cable to install two-way radio equipment

*Pulling cable is an everyday task of almost every radio technician. As a rule, in working on radios, amplifiers and antennas, developing good wire-pulling skills is important.*

---

By Roald Steen

---

Every mobile radio technician has to pull cable. It is one of the most common tasks, and it includes routing coaxial cables and control cables through vehicles and replacing worn and broken wiring.

Wire should be used and not seen. One objective in almost all wire-pulling situations is to conceal the wire. Safety is one reason; exposed wires can be tripped over easily. Exposed wires also are more likely to be damaged.

Routing cable is an inevitable part of radio installation in buildings. When a repeater is installed atop a building, normally it connects with a control console within the lower stories. Cable must be pulled between the floors.

Although radio technicians are knowledgeable when it comes to radios, amplifiers and antennas, their cable laying skills may not be as highly developed. Those with the broadest experience in installing cable include electricians and telephone company installers and repair technicians. Much of their work consists of routing and pulling cable, so they become good at it. Ask them for advice and suggestions when you are faced with what appears to be an insurmountable problem.

## Routing cable

In a room with a double ceiling, the cable may be routed along the top of the false ceiling. Use a small rubber ball attached to a string. Throw the ball from one open panel to another open panel some distance away. Attach the cable to the string and pull it across.

---

Steen is an electronics instructor and free-lance writer. He has worked as a two-way radio technician, and he lives in Woodbury, MN.

---

In a computer room, make use of the usual false flooring. The space between the false floor and the solid floor is designed for wiring.

Routing the cable from one floor to another can be more difficult. Passing the cable through the same hole used for pipes that go between floors may be the solution. Usually, enough space remains in the hole for the wire.

---

*Although radio technicians are knowledgeable when it comes to radios, amplifiers and antennas, their cable laying skills may not be as highly developed.*

---

If you have to install a long cable span, check the building blueprint to find electrical conduits or other spaces you may use.

## Building codes

Pay attention to building codes. Usually the wire you install in buildings is low-voltage wiring designed to carry signals, not power. Many of the codes that apply to electrical wiring may not apply to low-voltage signal wiring. If you are in doubt, an electrician or a telephone company installer may provide you with some guidance.

Tools needed for pulling wire include fish tape and a bracket that allows the wire spool to unwind with little friction. Well-designed junction blocks and punch tools

commonly are used by telephone company installers. You can purchase the same tools from an electrical supply house.

Your assignment may include installing a base station within a complex of buildings, such as a local government center or university. Tunnels may connect such buildings. If the control console is in one building and the base station or repeater is in another, you may be able to connect the two by routing the cable through a tunnel.

If a great deal of cable is involved, a conduit may be necessary. Installing conduit normally is a job for an electrician, who has the tools and experience to install conduit quickly and efficiently. Once the conduit is installed, you may be involved in pulling wire through the conduit and connecting the wire to equipment at each end.

## Weatherproofing

When the wire passes from the building interior to the exterior, the exit must be made weatherproof. For example, to connect a repeater to an outside antenna, coaxial cable often is routed through a wall.

When you install wire in a vehicle, conceal the wire as much as possible. Use hollow spaces in the vehicle to hide the coaxial cable that connects with the radio.

Speedometer wire may be used as a tool to direct a coaxial cable toward a hollow space. Push the speedometer cable through the space, then tape the coaxial cable to one end and pull it through. With this method, the coaxial cable may be brought through one of the roof supports and into the trunk where the transceiver may be mounted.

Vehicles ordered with the police accessory package may be delivered with a conduit installed between the front of the passenger compartment and the trunk. The conduit provides a ready-made route for the control cable to the radio. It protects



# Proven Performance. Increased Versatility.

We've made the "BEST"  
even "BETTER!"

By adding Scanning software and  
multi-channel capability to the  
SP-2000 Series Hand Portables –  
*We've made the Series better  
than ever!*

A variety of programmable Scan  
modes enable the radio's operation  
to be "customized" to the user's  
requirements – resulting in more  
effective two-way communications.

Choice of 4 or 16 channel versions  
provide additional versatility to any  
size operation!

Communicate "Better" today  
with the Scanning SP-2000!

**maxon**<sup>®</sup>  
*A World of Communications*

1-800-821-7848, Ext. 606 or 611

Circle (25) on Fast Fact Card





the cable from foot pressure and mechanical stress from sharp-edged objects.

At repeater locations equipped with towers, coaxial cable should be installed by the tower crew. The tower crew has the tools and experience to pull coaxial cable up the tower and to secure it.

#### Connectors

Connecting cable to the right equipment or communications lines at each end is part

of the installation job. Use durable, low-loss connectors.

Terminating lines in wall boxes such as those used by the telephone company offers an excellent way to maintain a clean installation. The last few feet of cable inside the dispatcher's office must not be forgotten. It should be as well concealed as possible, and not left lying on the floor where it may cause people to trip.

Drilling holes in concrete is one of the

most challenging tasks to be faced while installing a cable. Some older buildings, which usually have few conduits, are especially difficult to penetrate with a drill. They may be built with stone blocks. If you use the proper concrete drill bits and take your time, you should be able to drill through the hardest building materials.

#### Reusing wire

Sometimes, previously installed wiring can be reused. In most cases, it is difficult to determine which wires are not in use, and where they go. But if you find an appropriate, unused wire, it may offer a quick way to cover part of the distance you need to connect.

When wires are suspected to be defective, continuity checks usually will reveal any faults. Continuity checks are conducted more easily by two technicians, one at each end of the wire and in communication with one another by portable two-way radios.

Select a pair of wires and measure the resistance between them. You want a pair with no connection between them, so the resistance reading you want is infinity.

Ask the other technician then to place a clip wire across the pair. When the clip wire is installed, the resistance reading should drop to zero.

Measure the resistance between each wire and ground. Ungrounded wires are required.

It is common to find the environment is noisy where a two-way radio system is installed. A twisted wire pair that extends through many stories of a building picks up some of the electronic noise along its path. The use of shielded wires is recommended for communications system wiring.

#### Testing the wire

The final test of the wire installation is that the equipment it connects to works. Adjustments may have to be made to compensate for the wire's attenuation and frequency response. A long run of twisted-pair wire attenuates the signal more at higher frequencies than at lower frequencies. Also check for noise, to see whether the amount of noise the wire picks up can be tolerated by the system.


If the cable installation job is especially challenging, it may be better to lease a pair of wires from the telephone company. Or you may want to contract installers with more experience and the proper equipment to handle the job. An electrical contracting company is one place to look for technicians with cable-pulling experience.

**Lexstar®**  
**Premium Alexander Batteries**

More than a quarter-century experience is built into every Alexander Lexstar Battery. We're so confident in the Lexstar Battery we back its performance with the industry's only **TWO YEAR WARRANTY.**

**THE LEXSTAR BATTERY:**

- Is guaranteed to hold 80% of the battery's stated capacity for two full years.
- Includes state-of-the-art flexible circuit board technology for increased safety and reliability.
- Features electrical short-circuit protection device.
- Has computer matched cells for high capacity and even discharge.



For pricing, more information or to place an order call this toll-free number for the Stocking Warehouse in your region.

**Alexander Batteries**  
**1-800-526-ALEX, Ext. 2214**

Registered trademarks are the property of their respective owners.



# POWER ON... with ASTRON.

Astron Corporation is the leading manufacturer of high-quality power supplies and converters for the land mobile industry.

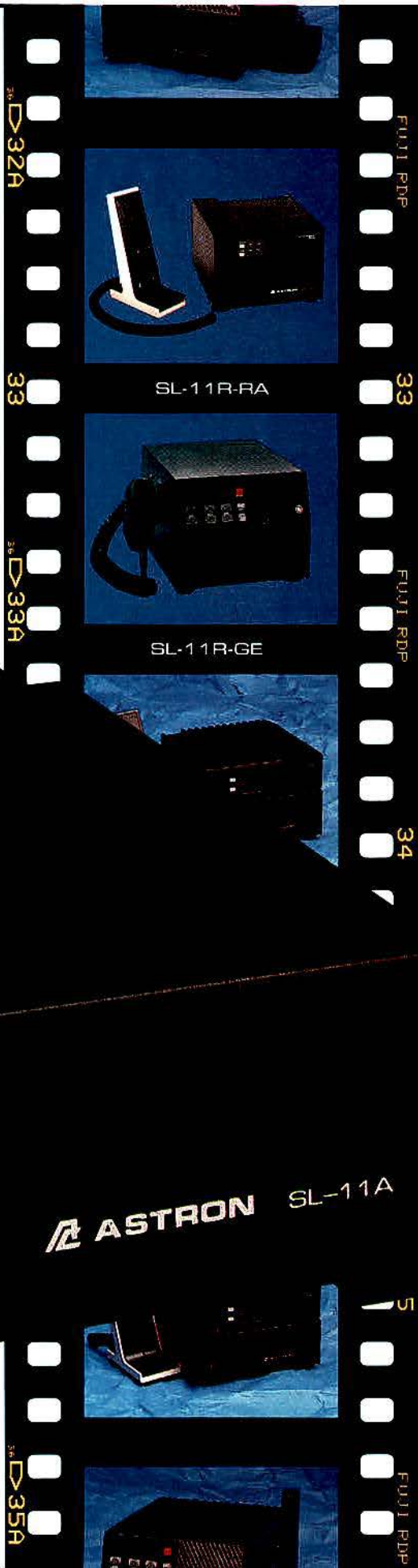
With the new SL-11 series of low profile power supplies, specifically designed for base station applications, the setup is simple, easy and looks attractive. Just mount the radio, with the mounting pads (supplied with the power supply), to the top of the SL-11A (2 3/4" H x 7 5/8" W x 9 3/4" D) or the SL-11R (2 3/4" H x 7" W x 9 3/4" D). The power supplies are very well regulated and will provide 11 amps of current at a 50% duty cycle. The units have fold-back current limiting to protect them from overload and short circuit, and an overvoltage protection feature to protect the radio should the output voltage exceed a safe level. All SL series units are available in dark gray or black.

Power supplies and converters from Astron: our unsurpassed quality and reliability have made us the #1 choice in the communications industry.



**ASTRON**  
CORPORATION

9 Autry, Irvine, CA 92718  
Telephone: 714/458-7277  
Facsimile: 714/458-0826



SL-11R-RA

SL-11R-GE

**ASTRON** SL-11A



# IWCE/Spring show preview/guide

Welcome to *Mobile Radio Technology's* pre-show coverage of the **1995 International Wireless Communications Expo/Spring**. Our editors have worked to provide a comprehensive overview of this annual mobile communications show. This section is designed to help you to plan your time at the show at the Las Vegas Sands Convention Center, April 25-27. Sections include:

- a pull-out map on page 32A, including a list of exhibitors and their booth numbers.

- a summary of exhibitors' products and services on display. Exhibitors listed include those who submitted information as of press time.

More than 300 mobile communications equipment manufacturers, distributors and service providers will convene at the Las Vegas Sands Convention Center, and many exhibitors will debut new products and services as they gear up for 1995. Products on display

will include antennas, accessories, cellular items, data communications, lightning protection equipment, mobile and portable radios, paging equipment, tone signaling equipment, towers and other wireless-related items.

For a rundown on what exhibitors plan to unveil and showcase at this Spring's Expo, refer to the **Products and Services** section beginning on page 33. The names of exhibitors who are also advertisers in this issue are **highlighted in blue ink**. Page numbers where you can find their respective advertising are also listed.

In addition to the new products that exhibitors will display individually, there will be a "New Products Information Center" where visitors may review new products and new product literature. Symposia at Expo will cover mobile communications industry opportunities and technical topics (see below). *Mobile Radio Technology* will be in booth 8019. See you at Expo!



## Tentative IWCE Symposia Schedule

### Tuesday, April 25

- Opening session: "Riding the Crest of the Worldwide Wireless Wave" (8:30 a.m. to 9:45 a.m.)
- "Out on the Rim: Asian Wireless Growth Opportunities"
- "Digital Linear Radio"
- "Wireless Applications for the Corporate Office"
- "The Latin American Connection: Wireless Opportunities in Voice and Data"
- "Test Equipment Rodeo"
- "Wireless Applications for the Campus Environment"

### Wednesday, April 26

- "Washington Insiders Roundtable"
- "Russia, the CIS and Eastern Europe: Technologies and Finances"
- "Narrowband Modulation"
- "FCC Open Roundtable"
- "International Trade Policy Update"
- "Inside Mobile Data"
- "Regulatory Summit"
- "A Technical Perspective of Digital Trunking Methods"
- "Wireless Applications for Public Safety"
- "The Changing Role of State Regulation"
- "Microwave: Create Technical Applications"
- "Creative Wireless Data Applications"

### Thursday, April 27

- "Paging Technology Update"
- "Fleet Management Applications"
- Special Closing Session: "Where Are We Going With PCS—Big Bucks or Big Bust?"

**Event:** International Wireless Communications Expo

**Dates:** April 25-27, 1995

**Location:** Las Vegas Sands Convention Center

**City:** Las Vegas

**Number of Exhibitors:** More than 300

**Projected Attendance:** 5,000 to 8,000

**Exhibit Hours:** Tuesday, April 25, 10 a.m. to 6 p.m.

Wednesday, April 26, 9 a.m. to 6 p.m.

Thursday, April 27, 9 a.m. to 2 p.m.

**Registration/Hotel Information:** 800-828-0420



The more you increase the coverage of cells and improve their quality, the more you'll save. In money, because you won't have to spend millions building more sites. In unhappy customers, because every site you already have will sound like a million.

Best of all, you can do it now. Right now. With a Celwave SMART System.



It increases your coverage by 40% with a stronger signal for consistently better quality between site and user. Between user and site, it automatically selects the path of least interference and improves in-building penetration. Instead of scattering effective radiated power, it focuses it while using lower energy levels to lower your utility costs. And it does it with less expensive equipment in less space.

If you want to make big gains in coverage and quality with what you have, get smart. Celwave SMART.

Call 1-800-CELWAVE for brochure.

**CELWAVE**

DIVISION OF RADIO FREQUENCY SYSTEMS INC.

2 Ryan Road Marlboro, NJ 07746-1899  
(908) 462-1880 • Fax (908) 462-6919

Circle (31) on Fast Fact Card



## Expo

### Bramco

#### Existing products

Tower light monitor/site management reporter; tone signaling products; ANI; remote control; mobile message center; Sel Call; replacement reeds and filters.

Circle 270

See classified ads

### Cadex Electronics

#### Existing products

C3000 and C4000 battery analyzers with interchangeable battery adapters for portable radios, cellular phones, laptop computers, video cameras

Booth 2081

and biomedical instruments. Simultaneously services nickel cadmium, nickel-metal hydride and SLA batteries and generates service report and labels with printer option.

Circle 271

See ad page 89

### Cajun Tower Systems

#### Existing products

Guyed and self-supporting steel communication towers.

Circle 272

Booth 3072

### Cal Crystal Lab

#### Existing products

Booth 3088

Quartz crystals ranging from 50kHz to 180MHz; clock oscillators from 250kHz to 100MHz; TTL, HCMOS and dual-compatible in full size, half size and surface-mount packages; Tri-state oscillators and gull wing leads on all oscillators also available.

Circle 273

See classified ads

### Cartwright Communications

#### Existing products

Combiners; duplexers; multicouplers; base station antennas; cable; connectors; sirens and warning lights; engineering services.

Circle 274

See ad page 85

### Cellular & Mobile International Booth 8019

#### Existing products

Published bi-monthly, *Cellular & Mobile International* provides decision-makers with articles that examine the technologies, applications and equipment of the international wireless communications industry. The circulation of 10,000+ reaches system operators, dealers, distributors, engineers, large-volume end-users (including public safety buyers) and manufacturers around the world, including European, Asian and Latin American markets.

Circle 275

### Cellular Business

#### Existing products

The first and leading trade publication for the cellular telecommunications industry. *Cellular Business* is published 13 times a year for cellular system operators, dealers, retailers, resellers, sales agents, distributors, engineers, large-volume end-users and manufacturers. The editorial addresses both technological developments and marketing concerns, with columns focusing on news, new products, sales strategies and data. Visit our booth to pick up a copy and sign up for your free subscription.

Circle 276

### Celwave

#### Existing products

Base station antennas; transmission line; combining product; filters/duplexers; receiver multicouplers; bidirectional amplifier; DCS service group.

#### New products

SMART System; BDA; Cellite series antennas.

Circle 277

See ad page 34-35

### Centurion International

#### Existing products

Antennas and batteries for LMR, cellular, PCS, PCN, PCMCIA and other wireless applications.

#### New products

CXS-MFP antenna for the Motorola Micro-Tac flip phone.

Circle 278

See ad page 9

### CeoTronics

#### Existing products

Headsets and communication systems for portable radios; TC 917 UHF wireless transceiver—a headset-integrated system; ear mics; throat mics; contact mics; surveillance systems.

#### New products

TC 917 UHF wireless transceiver; Contact Com-contact mic system for helmets and respirator masks; Ear-Mic 575 with adjustable amplifier; modular induction surveillance system.

Circle 279

# NEED POWER? SOLAR POWER!

## SOLAR ELECTRIC SPECIALTIES

*provides the  
highest quality  
photovoltaic power  
systems at the  
lowest prices.  
We can design a  
system to provide  
you with the  
power you need in  
the following  
categories:*

- Cellular Enhancers
- Microcells
- Telemetry/Data Acquisition
- Mobile Radios & Repeaters
- Microwave Repeaters
- Backup to Utility Power



**SOLAR ELECTRIC  
SPECIALTIES CO.**

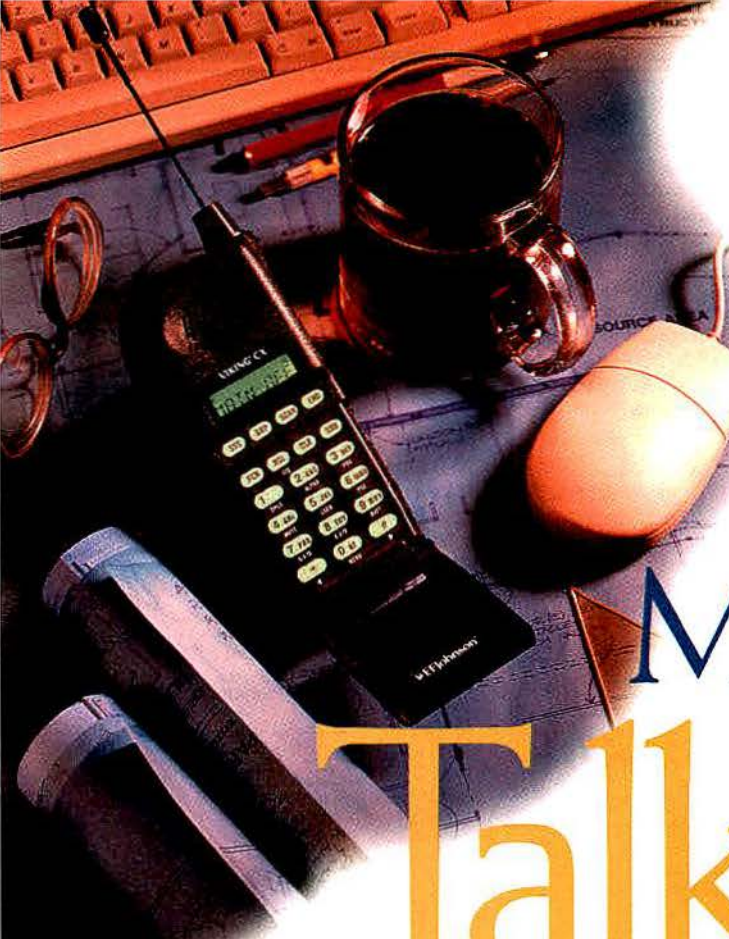
A DIVISION OF E. A. PADULA LUMBER CO., INC.

Featuring Siemens Solar Photovoltaic Modules

P.O. Box 537, Willits, CA 95490 Phone: (707) 459-9496 Fax: (707) 459-5132 Toll Free: (800) 344-2003

Circle (32) on Fast Fact Card





# Now It's a Lot Easier to Get Labor and Management Talking.

**I**ntroducing the Viking® CX and Avenger® SI:  
two new LTR® handhelds for all kinds of users.

For everyone who juggles a cellular phone and two-way radio, we designed the Viking CX—the smallest LTR radio on the market. Flip open the keypad cover, and the Viking CX becomes a *full-duplex* LTR handheld with clear audio, signal and battery strength indicators, and memory for up to 100 phone numbers. For people with simpler needs, the compact, easy-to-use Avenger SI delivers three watts of RF power, an alphanumeric dual-mode display, and MIL STD 810 durability. And for LTR system providers, the CX and SI are two hot competitors that will give your most demanding customers something to talk about. For information, call 1-800-328-3911, extension 6380.

**INTELLIGENT CHOICES FOR A WIRELESS WORLD.™**



Circle (33) on Fast Fact Card



**LTR®**

©1995 E.F. Johnson Co. Viking CX FCC approval pending.



## Expo

### C.E.T.

Booth 9096

#### Existing products

Airsite propagation study; CET 3500 3-dimensional terrain viewer; Fresnel zone study—microwave point-to-point; FCC license information.

Circle 280

See ad page 79

### ChargeGuard

Booth 5108

#### Existing products

ChargeGuard automatic on/off timer switch.

Circle 281

See classified ads

### Childs Antennas

Booth 1006

#### Existing products

Antennas for two-way radio, cellular, land mobile, marine and amateur/CB; 25MHz-1,000MHz hand-held, mobile, yagi and base station antennas; mount kits.

#### New products

Quarterwave chrome antenna.

Circle 282

### Christie Electric

Booth 9051

#### Existing products

CASP universal battery support systems.

#### New products

CASP/2000 and CASP/1200 universal battery support systems with cables and adapters for communications batteries.

Circle 283

### Cimarron Technologies

Booth 1086

#### Existing products

GE-Star-compatible ANI products; subminiature encoders; encoder/decoders; base dispatch dis-

play units; enhanced two-way GE-Star ANI systems with Man Down, EM, PTT, ANI, remote radio kill, enable, open mic and interrogate.

#### New products

Skymark vehicle tracker—GPS/AVL system includes mobile GPS receiver with mini RF modems, multichannel base controller and PC/CAD software running under MS Windows with worldwide mapping capabilities. Designed for existing voice and radio systems, both conventional and trunking.

Circle 284

### David Clark

Booths 3068, 3070

#### Existing products

Headsets with push-to-talk adapter cords for mobile and portable radios; voice-activated headsets for portable radios; headset intercom systems with two-way radio interface.

#### New products

Series 4200 communication system—each module is compact and can be mounted in either flush, vertical or horizontal position to simplify installation.

Circle 285

See ad page 23

### The Clip

Booth 2060

#### Existing products

The Clip; The ClipMate.

#### New products

The ClipMount; The ClipPlus.

Circle 286

### CNET

Booth 8059

#### Existing products

MIDAS microcell planning software tool; BOS network management software tool; WiNGS system planning software tool; traffic trending analysis software tool.

Circle 287

### Codan

Booth 9061

#### Existing products

8528I HF/SSB radio transceivers; IPC-500 telephone interconnect; 9003 scrambler; 8571 remote console; X-2 HF transceivers; 9300 ALE; 9480 HF transceiver; GPS.

#### New products

9001 fax and data modem for HF; X-3 HF/SSB transceiver with GPS; 9350 mobile antenna tuning.

Circle 288

### Coded Communications

Booth 1040

#### Existing products

Wireless mobile data systems; IQ modem Smart GPS; DXT mobile data terminal; CMX 4500, 4600, 4100, 1000.

#### New products

MCT 2000 series DOS-based mobile data terminals; CMX 4600 SMT terminal with card reader; Smart GPS vehicle location system.

Circle 289

### Comm-Net 2000

Booth 9047

#### Existing products

DG 200 programmable radio delay timers; DGRM 501-501B inband and crossband repeater modems.

Circle 290

See classified ads

# HUTTON STOCKS ANDREW AIR CABLE

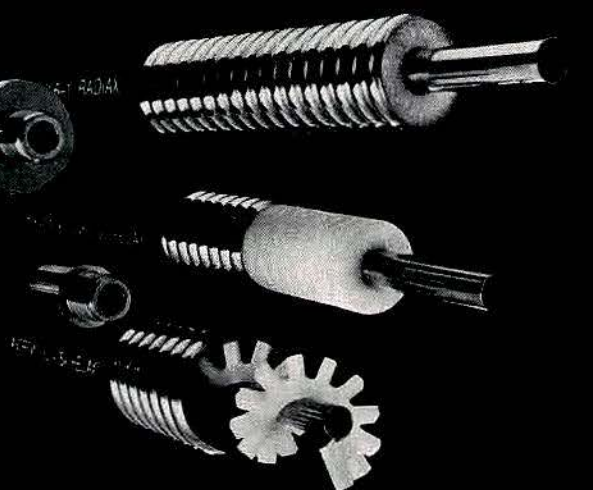
HELIAX® air-dielectric cables from Andrew are designed to give you the lowest attenuation and highest average power rating.

Hutton has up to 1 5/8" air ready to be cut to length and promptly delivered to your site.

Ready to ship  
to your site!



Arrestor Plus™ Surge Arrestor



**HUTTON**  
COMMWORKS

Dallas, Texas  
214-239-0580 800-442-3811

Atlanta, Georgia  
404-729-9413 800-741-3811

Toronto, Canada  
416-255-6063 800-265-8685

Denver, Colorado  
303-820-2929 800-726-6245

Seattle, Washington  
206-453-2132 800-426-2964

**ANDREW**

Circle (34) on Fast Fact Card



# Are We Confident Enough In EDACS To Send You To The Competition?



## Say When.

If you're actively looking for a digital trunked radio communication system, we'll send you to see an Enhanced Digital Access Communication System (EDACS®) installation, and then to a competitor's site. See both systems in action, talk to actual users about how their systems make them more productive.

There's no question that once you've seen the best that both companies have to offer, you'll choose EDACS.

Your productivity depends on communications getting through. EDACS' digital trunking allows instant access to key personnel throughout the organization, enhancing your company's productivity, and ultimately your bottom line.



And EDACS trunks voice and 9600 baud data on the same channels. It can send work orders to the field or monitor equipment up to 100 miles away. All without sacrificing voice communications.

What's more, EDACS is designed for compatibility with current and future technology. So your system can be expanded and modified as your needs change. That safeguards your investment.

EDACS. Once you see it, you'll believe it. To arrange your on-site visits, or for your free guide to EDACS, call Ericsson at 1-800-431-2345.\* (In Canada, call 1-804-528-7643.)

**Technology That Exceeds The Standard.**

\*Participants in above offer must meet general qualifications. Call for more information. Ericsson reserves the right to cancel or amend this program at any time.

EDACS is a registered trademark of Ericsson Inc.  
©1995 Ericsson Inc.

**ERICSSON**

Circle (35) on Fast Fact Card



## Communications Associates Booths 6049, 6051, 6053

### Existing products

Wholesale distributor of mobile communications products from the following companies: The Antenna Company, The Antenna Specialists, Celwave, Centurion, Larsen, Axiom, Ora, JVC Cellular, Mitsubishi DiamondTel, PanaVise, Bee, Astron and Motorola Spirit radios.

### New products

DiamondTel Mark 5 transportable cellular phone; Antenna Company K3+ glass-mount

antenna; Bee Durus nylon cases for two-way radios; Ora refillable battery packs.

Circle 291

See classified ads

## Communications Specialists Booth 5013

### Existing products

TS-32P series CTCSS encoder-decoder; SS-32P and SS-32SMP series CTCSS and burst tone encoders; PE-1000 series paging encoders; SD-1000 and PE-2P series two-tone sequential encoder and decoder; PE-4/PE-15 series POCSAG (RPC1) paging encoders; TP-3200 shared re-

peater tone panel; ID-8 Morse code station identifier; DCS-23 digital encoder-decoder; DTD-1 DTMF decoder; TS-64 CTCSS microminiature encoder-decoder.

### New products

TP-3200 shared repeater tone panel; CS1-100 video modem.

Circle 292

See BC

## Computer Resources Booths 9036

### Existing products

Sales and service management system; SMR billing system; pager billing and inventory system; accounting for two-way radio.

### New products

F16 pro accounting system.

Circle 293

See classified ads

## Comtelco Industries Booth 8097

### Existing products

BSXL series omnidirectional base station antennas; Y33 series yagi antennas; mobile antennas; mounts and accessories; antenna and antenna system couplers.

### New products

Multiple antenna array products and accessories.

Circle 294

## Connect Systems Booth 7035

### Existing products

TP-154 repeater tone panel; TP-154 Plus repeater tone panel/interconnect; CS-900, CS-800, CS-700, CS-6800, CS-8200, CS-9800 interconnects.

### New products

Connect Systems models LT-2, LT-2P, CD-2, CD-2P, TP-154D.

Circle 295

See ad pages 13, 72

## CPI Communications Booth 7068

### Existing products

Tone and dc remote controls and termination panels; local extensions; multichannel remote systems for use with Motorola Radius and MaxTrac radios; multisystem/subfleet remote controls for use with Motorola MaxTrac trunking radios; dc to tone control conversion unit.

### New products

MCR310/MCR320 multichannel remotes for use with Midland Syn-Tech XTR radios; DR series dc remote controls; DTP series dc termination panels.

Circle 296

See ad page 86

## CTI Booth 5046

### Existing products

Wee-Page; Mitee-Page; Page Master Phase II; Mobile Master Phase II; SF-65 page repeater; DID/SMR 3-5; TXC 100/200 remote base station controllers; Opti-Page voice mail/paging terminal; SX-96 trunk controller.

Circle 297

## Cushcraft Booth 5047

### Existing products

Base station products for frequencies ranging from 25MHz to 2.5GHz; control station and mobile products for most of the same range.

### New products

PC806N and PC906N six-element yagis for 800MHz and 900MHz.

Circle 298

## Cylink Booth 9037

### Existing products

AirLink wireless modem; AirLink bridge.



STI-CO's new **800 Series (XXX-S-800)** cowl-mount disguised antennas cover 60 MHz minimum within the **806-866 MHz** cellular and trunking frequency range, **and are exact AM/FM antenna replacements** for select Ford, Chrysler and GM body styles.

For additional information (or to order) try our new **800 fax number: 1-800-685-1122!**

Join the 800 Club with . . .

The  
**DISGUISE GUYS**



11 COBHAM DR. ORCHARD PARK, NY 14127 (716) 662-2680 FAX 1-800-685-1122

Visit us at IWCE/Spring, Booth #7061

Circle (36) on Fast Fact Card





**JBRO**  
BATTERIES, INC.  
RECHARGEABLE, SEALED  
NICKEL-CADMIUM  
BATTERY

CAUTION: Battery may explode if disposed of in fire.  
Lisle, IL 60532

# YOU NEED POWERFUL FRIENDS IN THE RIGHT PLACES.

JBRO puts ultra dependable mobile communications performance right in the palm of your hand...with the industry's most trusted line of high quality land mobile batteries.

Manufactured to uncompromising quality standards, JBRO rechargeable batteries carry maximum power ratings to provide extra-reliable service in the harshest operating environments. With a complete array of sizes and models,



**JBRO**  
BATTERIES, INC.

JBRO has exactly the right battery to satisfy your specific application.

And keep your rechargeable batteries performing at optimum levels while extending useful life with JBRO's line of Telepower Conditioner/Analyzers.

Call today for a free catalog on the industry's broadest line of finest quality batteries.

Shake hands with a powerful, dependable friend...your JBRO battery!

Visit us at IWCE/Spring, Booth #5059.

JBRO Batteries, Inc. 1938-A University Lane Lisle, IL 60532-2150 • Phone: 708/964-9358 Fax: 708/964-9081 Order Entry: 800/323-3779 Fax Entry: 800/237-6435  
JBRO Batteries S.W., Inc. 25700 I-45 North #111 Spring, TX 77386 • Phone: 713/367-9393 Fax: 713/292-7139 Order Entry: 800/245-1138

Circle (37) on Fast Fact Card



## New products

T1 radio/wireless.

Circle 299

## D&L Two-way Wholesale Dist. Booth 8069

### Existing products

GE mobile radio; GE portable radios; GE repeaters and base.

### New products

MASTRIII hot standby transfer; high current power down timer; battery conditioner for GE batteries.

Circle 300

## Daniels Electronics Booth 3104

### Existing products

118MHz-960MHz synthesized narrowband radio modules; crossband repeater systems; trans-portable emergency radio systems.

### New products

Telephone base and telephone remote modules; radio data interface card.

Circle 301

## DataCom Booth 9091

### Existing products

4WFD wireless data line; 2WFD wireless telephone line; 2WEL wireless telephone line; RRC-93 SCADA products.

### New products

2WFD wireless telephone line.

Circle 302

See ad page 50

## Dealers' Product Source Booth 8019

### New Products

This new, "special event" tabloid from the publishers of *Mobile Radio Technology* and *Cellular Business* delivers 100% product coverage to a unique audience of wireless communications dealers and retailers. Visit our booth to pick up a copy and sign up for your free subscription.

Circle 303

## DINET Booth 1058

### Existing products

Data-Mate series 1000, 1500, 3100 MDTs; AVL/GPS tracking system.

### New products

Data-Mate 600 MDT; DataMate 800 MDT.

Circle 304

## Douglas Integrated Software Booth 7108

### Existing products

ComSitePlus radio interference analysis software; DesensePlus transmitter noise/receiver desense software; IntermodPlus intermod signal analysis software; Imight intermod hit list software.

### New products

ComSite Manager wireless comm site database; RadComPlus communications site RF radiation analysis software; communications site management, acquisition and development services.

Circle 305

See ad page 87

## Duracomm Booths 8075, 8077

### Existing products

Tone and voice pagers; paging terminals; power supplies.

## New products

SS-22 desktop power supply; SS-7 desktop power supply; modular rack-mount or desktop power supplies; TP-040 lowband pager.

Circle 306

See classified ads

## DX Radio Systems Booth 1008

### Existing products

Paging—DX6000; AM, VHF ground-to-air communications—835, 9800, 9100, 9150; radio telephone links—Condor one-line link.

### New products

Eclipse series repeaters; Hawk two-line radio telephone links.

Circle 307

## Dynatech Tactical Communications Booths 1053, 1055

### Existing products

Accessories for two-way radio communications: RHS-1, RHS-2, RHS-5, RHS-6, RHS-7, RHS-8 headsets; PTT adapters; Vox adapters; SK-3, SK-5, SK-7, SK-9 surveillance kits; R-4, R-1 wireless receivers; Z-8, Z-8L transducers.

### New products

Tactical surveillance kits.

Circle 308

## Eagle Telecom International Booth 3080

### Existing products

Power amplifiers; paging base stations; transmitters; receivers; transmitter controllers; in-house paging terminals; satellite-based systems design and engineering support.

Circle 309

See ad page 27

# GAMBER-JOHNSON

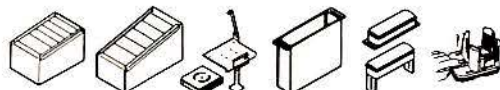
## MCS-100 SERIES

The Gamber-Johnson MCS-100 Series is an economical alternative to consoles for mounting voice and data communications equipment in your Caprice or Crown Victoria.

Our base is one piece, made of 3/16" electrostatically powdercoated steel. For safety, all edges are milled and corners rounded. Our design allows installation in minutes without drilling or modifying the vehicle. Our radio brackets are universal and simple to install and adjust. The 22 1/2" mounting surface gives you room for up to six sets of radio brackets, or a combination of brackets and a Gamber-Johnson MCS Series MDT or Laptop/Notebook mount. We even offer an adjustable armrest to assure an ergonomically correct work station.

The simplicity and strength of our design provides a margin of safety unsurpassed in the industry, and ease of installation which saves you time and money. Of course, the MCS-100 system is air bag friendly when properly installed, and, if desired, may be upgraded to an enclosed console protecting your initial investment years into the future.

Partial accessory sampling



# MCS-100 SERIES



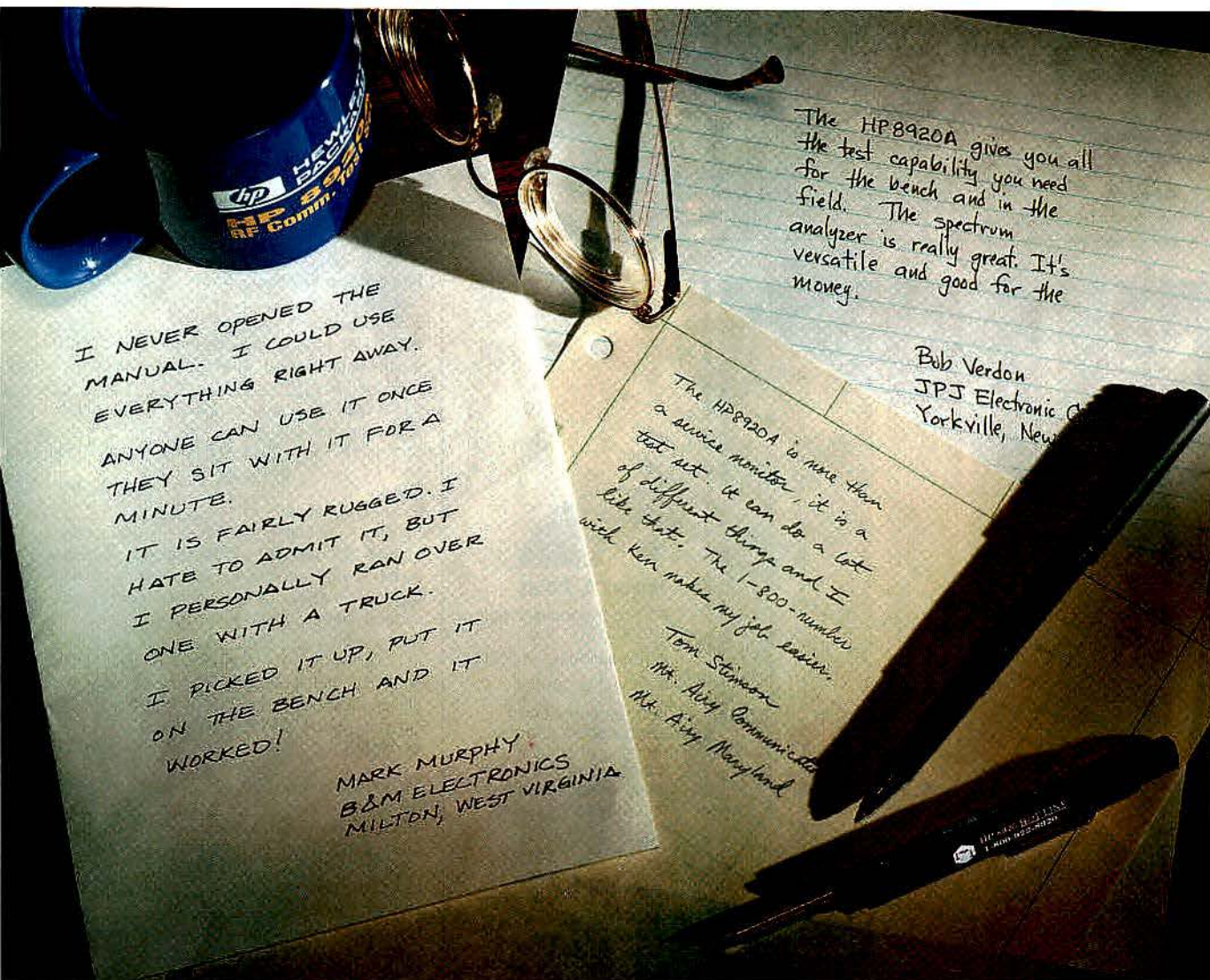
For information now  
CALL 1-800-GJ-MOUNT 1-800-456-6868  
FAX 1-800-WE-HELPP 1-800-934-3577

**GAMBER-JOHNSON**  
*Service & Solutions™*

801 Francis Street, Stevens Point, Wisconsin 54481



# "I never opened the manual for my HP 8920A."



Either the new HP 8920A RF Communications Test Set is easy to use, or the people who use it are particularly intuitive.

We can't vouch for the latter, but there's a lot we can offer about

the former. Like what, you ask? Like the fact that virtually every RF test you'll ever need to do is available at the push of a front-panel button.

The result? You get your job done faster. And better. Because the HP 8920A provides high-performance spectrum analysis, built-in encode/decode capabilities for paging and trunking, and easy-to-use software for fast, repeatable, documented results.

Speaking of pushing buttons, just push **1-800-344-3802** and ask for **Ken** or **Charlie**. They're two seasoned vets who can answer all your questions. They can also give you the details on how to get the HP 8920A for under \$12,500.

The HP 8920A — the end of manual labor.

## Latest Enhancements

- Variable frequency notch filter for SINAD (300 Hz to 10 kHz)
- 5% power measurement accuracy
- Signal/noise ratio measurement
- Adjacent channel power measurement

There is a better way.





## EDX Engineering

Booth 2087

**Existing products** \_\_\_\_\_  
MCS PCS ray-tracing propagation prediction software; SIGNAL comprehensive coverage and link analysis software; MSITE cellular and multisite coverage and interference analysis software; TPATH point-to-point, multiple link path analysis; terrain elevation data for Canada, Great Britain, Mexico and the United States.  
**Circle 310**

## E.F. Johnson

Booth 4021

**Existing products** \_\_\_\_\_

Avenger product line of mobiles and handhelds; Viking family of products, including networking and repeaters.

### New products

Viking CX handheld; Avenger UHF handheld; Viking LR 200MHz mobile; Viking VX 900MHz repeater; 3480 spread spectrum telemetry unit; 3250 telemetry remote sensor.

**Circle 311**

See ad page 37

## El Paso Communication Systems Booth 1102

### Existing products

HF, VHF, UHF, 800MHz radios—mobiles, por-

tables, base stations and repeaters from Motorola, Kenwood, Uniden, Maxon, Yaesu, Midland and Standard; radio modems; telephone interconnects; antennas; coaxial cable and connectors; power supplies; solar modules; radio alarms; accessories; parts.

### New products

EWM-1200 GPS—automatic vehicle location system; Digi-Voz TX voice radio alarm; T Link 2100 point-to-point or multipoint full-duplex interconnect/telephone line extender; T Link 2300 point-to-point or multipoint interfaces for conventional telephone modems to radios.

**Circle 312**

See classified ads

## ElectroCom Communication

Booth 4051

### Systems

**Existing products** \_\_\_\_\_  
MDC-890 mobile data computer; MDT-870 mobile data terminal; diversity radio controller.

### New products

9,600-baud radio modem; MDC-890/IM mobile data computer.

**Circle 313**

See ad pages 88, 93

## ENIR

Booth 3103

### Existing products

Isolators; circulators; loads; cavity resonators; mobile duplexers; base station duplexers; transmitter combiners; receiver multicouplers; tower-top receiver multicouplers; bidirectional systems; unidirectional systems.

### New products

ML series mobile duplexers (VHF, UHF, 900MHz); EH series six-cavity base station duplexers (from 72MHz to 1GHz); high power, 10" cavity resonators (VHF, UHF, 900MHz).

**Circle 314**

See ad page 72

## Enviro-Buildings

Booth 9093

### Existing products

Modular communication shelters.

**Circle 315**

## Ericsson

Booth 3003

### Existing products

Enhanced Digital Access Communications System and products, including Allegra, M-RK, PCS, M-PA portable radios and MDX, MDR and Orion mobiles.

### New products

Prism HP portable radio; MDS system model; Monogram 16-channel scan; M-RK I/S portable radio.

**Circle 316**

See ad page 39

## ETrunk

Booth 6017

### Existing products

ETR500 series base stations and repeaters; VHF/UHF trunking boards; VHF/UHF trunking systems.

### New products

ETR1000 trunking/conventional repeater panel offers ETrunk's new digital protocol, telephone interconnect and standard ETrunk protocol.

**Circle 317**

See classified ads

## Everon America

Booth 6104

### Existing products

EP-110/910 EverReach digital display pager.

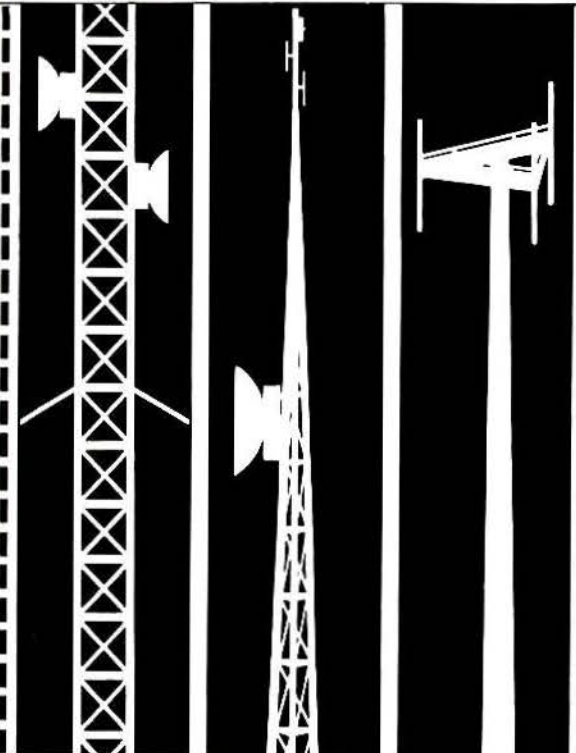
**Circle 318**

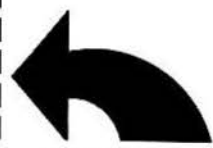
See ad page 58

## Fanon Courier

Booths 4096

### Existing products






**Towers & Poles**

- Free Standing design to 400'
- Tubular Steel to 250'
- Guyed to 1000'

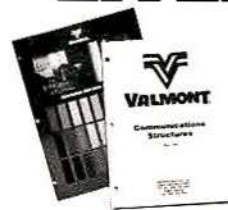
In-house engineers design poles and towers to your specifications. Full range of finishes with installation and leasing available.



**VALMONT**

Valmont Industries, Inc.  
Valley, Nebraska 68064  
(402) 359-2201  
Fax: (402) 359-5856

FREE TOWER LITERATURE



☐ **PLEASE fill in and mail this coupon for free information on communication towers.**

NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

MAILING ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

OFFICE TELEPHONE (     ) \_\_\_\_\_

Circle (40) on Fast Fact Card



# "YOUR BUYER'S GUIDE REPLACES THE 10 TO 20 CATALOGS WE USED TO USE. IT'S BY FAR THE BEST I'VE EVER SEEN!"

J. R. Rzucidlo

Radio/Metropolitan Communications, Inc.

12,000 Items.  
Over 170 Manufacturers.  
850 Pages.

Easy to use and fully indexed with complete product specs and guaranteed pricing.

Simplify your life. Call, fax or write to reserve your complimentary\* copy of the wireless industry standard.

800.472.7373  
410.472.7575 fax



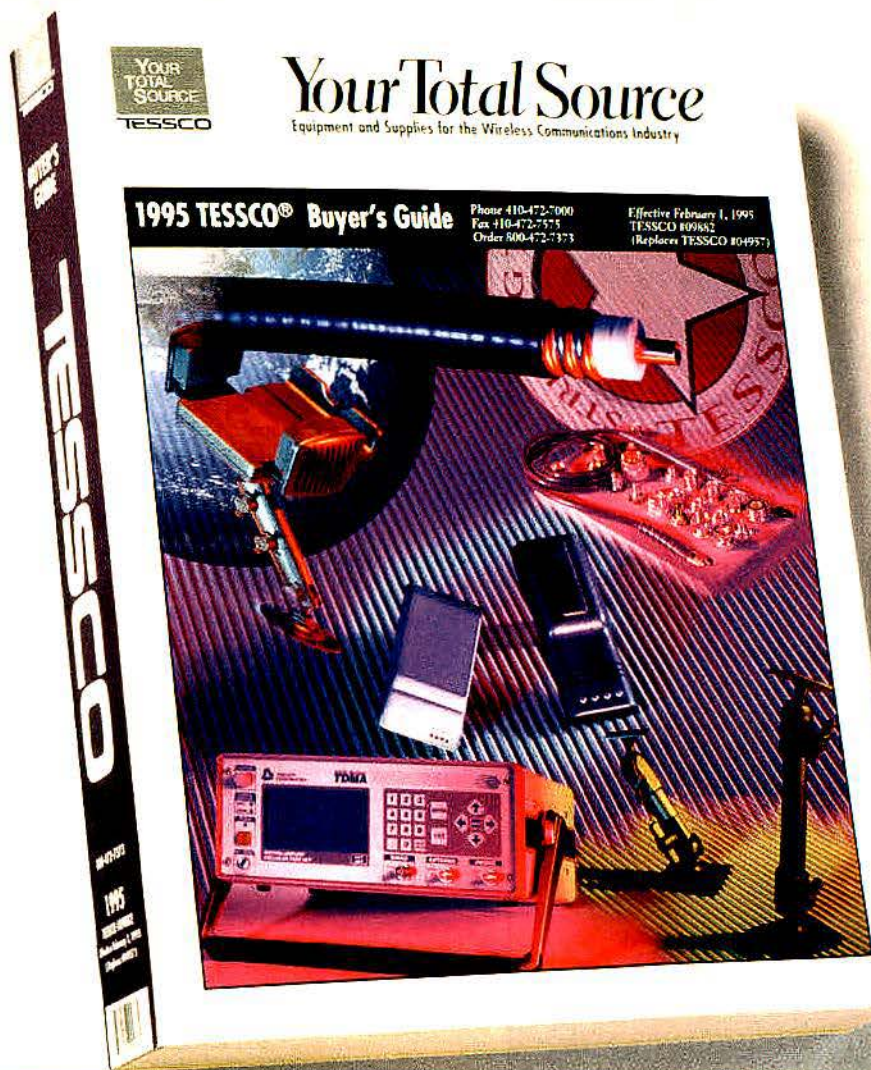
NOT  
JUST A  
CATALOG



TESCO  
34 Loveton Circle  
Sparks, MD 21152-5100 USA  
800.472.7373  
410.472.7575 fax

\*Complimentary to qualified service organizations

1007





Courier Procom M54 and MU54 5W, four-channel portable VHF and UHF transceivers; Procom U22 2W, two-channel portable UHF transceivers; Fanon megaphones; intercoms; P.A. amplifiers; paging/talkback speakers; paging systems.

## New products

Procom M510 5W, 10-channel synthesized programmable portable VHF transceiver; Procom MU510 5W, 10-channel synthesized programmable portable UHF transceiver.

Circle 319

See classified ads

## Fibrebond

Booth 3072

### Existing products

Communication shelters; mobile cells; equipment installation services.

### New products

Ultra maintenance-free shelter.

Circle 320

## Flash Technology

Booth 2082

### Existing products

ElectroFlash FTB 310 medium intensity white obstruction beacon.

## New products

ElectroFlash FTB 312 dual medium intensity beacon in a single 400mm Fresnel lens.

Circle 321

## Freeman Engineering Assoc.

Booth 4075

### Existing products

PVM family of paging, voice storage and PCS terminal products.

Circle 322

## Frequency Management

Booth 4103

### Existing products

Crystals for pagers, land mobile, microprocessor, military and custom OEM products; complete channel elements or installation in customer-supplied channel elements; oscillators: HC-MOS, TCXO, VCXO, Tri-State.

Circle 323

## Gamber-Johnson

Booth 6043

### Existing products

NotePad universal laptop/notebook computer mount; Mission Control air bag-friendly mount system.

### New products

NotePad universal mounting solution for mobile use of notebook/laptop computers; MO-1000 air bag-friendly portable seat mount base for mobile office equipment.

Circle 324

See ad page 42

## General Communications

Booth 3086

### Existing products

Ericsson two-way radios; Orbacom consoles; aftermarket services and accessories.

Circle 325

See classified ads

## Glenayre

Booth 7103

### New products

Modular Voice Processing (MVP) multi-applications platform (MAP) system.

Circle 326

## Granger Telecom

Booth 9089

### Existing products

DTL-7300 series multiplex.

### New products

PTP-960 microwave radio.

Circle 327

## GRE America

Booth 5103

### Existing products

GINA 900MHz spread-spectrum transceivers—no FCC site license required.

### New products

GINA model 7000N, 8000N, 8000N-5; 2.4GHz spread-spectrum transceivers—no FCC site license required.

Circle 328

## Harger Lightning Protection

Booth 5104

### Existing products

Ground bars; arrester brackets; lightning arrestors; miscellaneous grounding equipment.

Circle 466

See ad page 81

## Hark Systems

Booth 1065

### Existing products

SI-550EX with Author software for SMR networking; SMR/voice mail; Mega Switch for SMR networking; TMPP network controller; Verifier paging decoder; TAP 200 alphanumeric concentrator.

### New products

# Tripp Lite DC Power Supplies New Models. Better Profits.

**NEW**

**12, 20, 30  
and 50 Amp  
Models!**



## Fully expanded line of DC Power Supplies

Now Tripp Lite's line of DC power supplies cover the full range of amperages, including the popular **12 and 20 amp** radios. For dealers, Tripp Lite provides outstanding customer service before and after the sale. Best of all, Tripp Lite DC Power Supplies earn you **\$1.16 more profit per amp** per model than the leading manufacturer's models.

## DC POWER SUPPLIES

### Models Available:

3 amp	4.5 amp	7 amp	10 amp
12 amp	15 amp	20 amp	25 amp
30 amp	40 amp	50 amp	60 amp

- 120/220/240 volt configurations, including rackmount models
- Crowbar overvoltage protection and foldback automatic overcurrent protection
- Complete isolation from noise on incoming AC power

## Power Supply-

Call for Details

(312) 755-8741

Dept. PR1

**FREE!**



500 N. Orleans, Chicago IL 60610  
Tel: (312) 755-8741 · Fax: (312) 644-6505  
Faxback: (312) 755-5420

**All Models Stocked By Distributors Nationwide**

Circle (41) on Fast Fact Card



# WHERE ONE GREAT IDEA MEETS FIVE GREAT MICROPHONES.



## MODULINK SYSTEM 1

### SHURE'S MOBILE MICROPHONE AND MODULAR CORDSET SYSTEM.

Shure's ModuLink System 1 offers four handheld microphones and one base station microphone designed to meet your particular application requirements. All ModuLink microphones combine ease-of-use, state-of-the-art features, quality, and economy.

## CONNECTION AND CORD REPLACEMENT IS A SNAP!



The key to the ModuLink system is the innovative modular cordsets, which allow our microphones to quickly connect to virtually all popular radio transceivers — *without any hard-wiring*. Should a cord fail, it can be replaced in thirty seconds, even in the field. Simply unplug the failed cordset and snap in a new one. You save technical service time, eliminate downtime and drastically reduce inventory costs.

## BUILT TO PERFORM AND BUILT TO LAST.

All ModuLink handheld microphones feature Top-Talk Sound Channels™ for clear communication, a Million-Cycle Plus® leaf switch for longer trouble-free use and an Armo-Dur™ case for durability. The Base Station microphone also features a Million-Cycle Plus leaf switch and is built just as tough.

For more information on Shure ModuLink microphones, cordsets and compatible transceivers, call **1-800-25-SHURE**.

Circle (42) on Fast Fact Card

### 550T

Base Station transistorized microphone features adjustable gain and a split-bar monitor transmit switch.



### 590T

Handheld transistor amplified dynamic microphone is a rugged workhorse designed for years of trouble-free service.



### 592T

Electret Condenser microphone, with our patented noise-canceling bi-directional pick up pattern, is perfect for high-noise settings.



### 885TT

Manual-Dial DTMF microphone includes continuous-tone dialing, an illuminated keypad and positive tactile keys for easy number entry.



### 888TT

888TT DTMF Aircraft microphone is amplified, noise-canceling and FAA Certified for aircraft application (TSO-C58a).



# SHURE®



## Expo

Mega Switch with enhanced software for "one number follow-me," least cost routing and many other customer-controlled features.  
**Circle 329**

**Helper Instruments** **Booth 5052**  
*Existing products*  
Test equipment for the wireless, cellular and PCS markets, including Sinadder series SINAD meters; a service monitor; Matchbox self-contained antenna testers; power supply; an RF millivoltmeter; the Lineman phone line tester.  
**Circle 340**

**Hewlett-Packard** **Booth 1069**  
*Existing products*  
HP8920A/BRF communications test set; HP8921A/D cell site test system; HP83203B CDMA cellular test system; HP8594E spectrum analyzer with CDMA, TDMA personalities; HP8647A signal generator; HP8711A network analyzer.  
*New products*  
HP89203B CDMA cellular test system; HP8920B RF communications test set.  
**Circle 341** **See ad page 43**

**Richard Hirschmann of America** **Booth 8043**  
*Existing products*  
Land mobile communications antennas; base station antennas; shielded 3/4" NMO-compatible antenna mounts.  
*New products*

1.8GHz and 2.4GHz PCS patch antennas.  
**Circle 342**

**Hughey & Phillips** **Booth 3066**  
*Existing products*  
FAA-approved obstruction lighting for tall towers.  
*New products*  
Flashguard 3000 dual red-white strobe beacon.  
**Circle 343**

**Hustler** **Booth 9016**  
*Existing products*  
Spirit and Heavy Duty series verticals; G6-450 and G7-150 series verticals; CMT-800 cellular magnetic mounts; BBL series VHF mobiles.  
*New products*  
HM6-82496 marine 6dB cellular vertical; HS9-90228 9dB spread-spectrum vertical; DR9-800 series 800MHz yagis; DR9-900 series 900MHz yagis.  
**Circle 344** **See ad page 51**

**Hutton Communications** **Booth 7078**  
*Existing products*  
Cellular accessories from more than 80 industry manufacturers, including Andrew, Antenna Specialists, Celwave and Decibel Products.  
*New products*  
Cellular phone holders, including HCP HC-PC3, HC-PC6 and HC-PC6A; HCP soft leather cases for most cellular phone models.  
**Circle 345** **See ad page 38**

**Hy-Q International** **Booth 4083**  
*Existing products*  
Precision quality quartz crystals; oscillators; monolithic filters for use in wireless communications products.  
**Circle 346** **See classified ads**

**ICOM America** **Booth 6021**  
*Existing products*  
UHF and VHF mobiles and portables; single sideband transceivers; repeaters; general coverage receivers.  
*New products*  
IC-F10 and IC-F20; IC-F30LT and IC-F40LT.  
**Circle 347**

**ICT** **Booth 1064**  
*New products*  
ICT 12012-20AS switching power supply—20 amp.  
**Circle 348**

**IDA** **Booth 4056**  
*New products*  
20-88 multiline remote console; 40-70 multi-user interconnect; Net-Link with Word Saver.  
**Circle 349**

**Idaho State University** **Booth TBA**  
*Existing products*  
Training of entry-level electronics technicians; programs in RF land mobile telecommunications, electromechanical, instrumentation, laser and electronic systems—associate

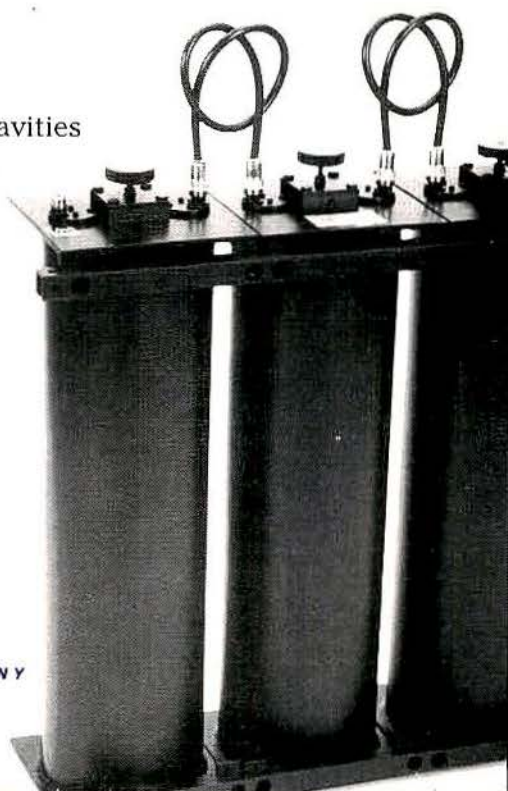
## HIGH Q FILTERS NOTCH AND BANDPASS

- Low loss
- Broad frequency range  
30-950 MHz
- Single, double & triple cavities  
for spot or wider band  
attenuation
- Excellent power  
handling &  
temperature stability
- Field tunable

For more information,  
request our data sheets  
for HIGH Q FILTERS.

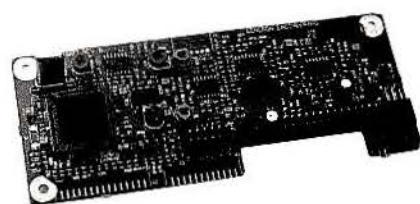


**MICROWAVE FILTER COMPANY**  
6743 KINNE STREET  
EAST SYRACUSE, NY 13057  
800-448-1666 • 315-437-3953  
FAX: 315-463-1467



Circle (43) on Fast Fact Card

## GENCRON ENGINEERING, INC. INTRODUCES COMMUNITY REPEATER COMPATIBLE UHF LTR® TRUNKING!



- Vertex FTL-7011-TR LTR® Trunked & 99 Ch. Conventional Radio, 25-2 watt programmable
- Conversion Board "UTB®" easily installed ~~replaces existing~~ FTL-7011 Logic Board
- Dealer price complete Trunking Mobile Radio.....\$388.60
- Conversion Board ..\$99.95
- Programming Cable, Software and Manual .....\$94.00

**GENCRON ENGINEERING, INC.**

800-556-8866, Fax 619-792-6688  
P.O. Box 910225  
San Diego, CA 92191-0225

LTR® is a registered trade mark of the E.F. Johnson Co.  
Vertex is a registered trade name of Yaesu USA.

Circle (44) on Fast Fact Card



# THERE

*Superior mechanical durability... greater transmit range... more efficient*

# ARE MANY

*RF designs... toll-free service and order-entry hotlines... best warranty in*

# REASONS

*the business... fast turnaround on special orders... we listen to your*

# TO SWITCH

*input and act... satisfaction always guaranteed...*

# TO LARSEN.

INCLUDING PUTTING  
YOUR OLD ANTENNAS  
TO BETTER USE. →



Read between the lines and you'll begin to see why Larsen antennas are the best in the business. And why we're the clear choice for dealers and users worldwide. Now that you've got the itch to switch, scratch it by calling 800-426-1656. Fax: 360-944-7556.

 **Larsen®**  
The Clear Choice™

Circle (45) on Fast Fact Card



and bachelor of applied technology degrees.  
Circle 350

## IFR Systems Booth 1014

**Existing products**  
Full line of communications service monitors and spectrum analyzers.

**New products**  
µcell-100 tester for AMPS, NAMPS and TDMA cellular handsets.

Circle 351 See ad page 53

## Interactive Systems Booth 5111

**Existing products**  
Interactive access to FCC licensee data, including land mobile, common carrier, PCS, towers and many other FCC licensee databases.

**New products**  
Interactive map generation using data from FCC licensee database.

Circle 352

## International Crystal Mfg. Booth 1046

**Existing products**  
Quartz crystals; custom two-way channel elements; pagers; radios.

**New products**  
Motorola pagers and pager products.

Circle 353 See classified ads

## JB Communications Booth 2073

**Existing products**  
CB and cellular custom and stock cable assemblies; antennas; mounts; cases; batteries; acces-

sories; other custom-type cable assemblies.  
Circle 354

## JBro Batteries Booth 5059

**Existing products**  
Replacement rechargeable batteries for land mobile market, including two-way portable radios, pagers, portable data collection devices; Telepower conditioner/analyzer battery maintenance systems.

**New products**  
High-capacity replacement rechargeable batteries for Motorola STX radios, Motorola Saber radios, Uniden APX-1100 radios and Maxon SP2000 radios.

Circle 355 See ad page 41

## JFW Industries Booth 8111

**Existing products**  
Programmable attenuators; fixed attenuators; variable attenuators; solid-state RF switches.

**New products**  
JFW 50MS-028 4 x 4 matrix switch; JFW 50PD-110N two-way power splitter.

Circle 356 See ad page 76

## Kaval Electronics Booth 8103

**Existing products**  
KV-OFB, KU-OFB, K8-OFB on-frequency radios; KVB, KUB, K8B booster amplifiers; KVL, KUL, K8L line amplifiers; tapped radiator products—signal taps, antennas, splitters.

**New products**  
ACT-XX-750, CCT-XX-750 signal taps for ¾"

cable; KTIS 60V ac line amplifier powered over the cable.

Circle 357 See ad page 70

## Kenwood Communications Booth 1019

**Existing products**  
VHF, UHF portables, mobiles, base stations and desktop repeaters; 30 series dash-mount, single-head remote, dual-head remote and dualband remote; trunking portables, mobiles and repeaters; options and accessories for all products.

**New products**  
TK-840 UHF (403MHz-512MHz) trunking mobile, 25W; TK-940/941 800MHz/900MHz trunking mobile, 15W; TK-250/350 VHF/UHF portable, 5W/4W; Kenwood systems group TKR-9300S/9301S 800MHz/900MHz trunking systems.

Circle 358 See ad page 69

## KNS Electronics Booth 5109

**Existing products**  
7125, 7135 communications service monitors; K-30 selective level meter.

**New products**  
K-40 paging signal generator.

Circle 359 See classified ads

## Kyodo West Booth 3027

**Existing products**  
VHF and UHF land mobile communication products, applications and system integration.

**New products**

## In Wireless Communications One Name Stands Out...

**DataCom Inc.**

### Wireless Telephone Line



Model 2WFL

- Fully Synthesized
- Multipoint to Multipoint Operation
- Automatic Interference Detection
- Frequency Switching Capability
- Voice Encryption
- True Full Duplex Operation

### Wireless 4-Wire Lease Line Replacement



Model 4WFL

- True Full Duplex Operation
- Supports V-Fast Modems
- 100% Duty Cycle
- Diagnostic Front Panel

### Radio Switch



Model DRS-010

### Radio Remote Control



RRC-93 SCADA

- Affordable Price
- Low Power Consumption
- Eliminates Leased Lines
- Dependable (Hands Off) Operation

DataCom... fast becoming the leader in top quality, affordable wireless communication equipment. From telephone line replacement, SCADA Remote Control, to Radio Switching... all RF configured to include the highest level of quality, service and customer satisfaction. —Our customers tell us this—

Let us tell you the many ways we can save you money and increase your sales. We are increasing our dealer network. If you are interested in representing this quality product line, please call or fax us.

520 No. 30th P.O. Box 3485 • Quincy, IL 62305 USA • Tel.: (217) 222-0160 • Fax: (217) 222-0912

Circle (46) on Fast Fact Card

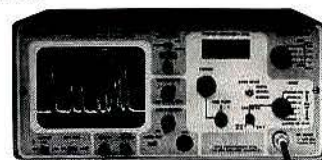
## AVCOM's New PSA-65A Portable Spectrum Analyzer

The newest in the line of rugged spectrum analyzers from AVCOM offers amazing performance for only \$2,855.

AVCOM's new PSA-65A is the first low cost general purpose portable spectrum analyzer that's loaded with features. It's small, accurate, battery operated, has a wide frequency coverage — a must for every technician's bench. Great for field use too.

The PSA-65A covers frequencies thru 1000 MHz in one sweep with a sensitivity greater than -95dBm at narrow spans. The PSA-65A is ideally suited for 2-way radio, cellular, cable, LAN, surveillance, educational, production and R&D work. Options include frequency extenders to enable the PSA-65A to be used at SATCOM and higher frequencies, audio demod for monitoring, log periodic antennas, 10KHz filter for .2 MHz/DIV range, carrying case (AVSAC), and more.

For more information, write, FAX or phone.



**AVCOM** BRINGING HIGH TECHNOLOGY DOWN TO EARTH

500 SOUTHLAKE BOULEVARD  
RICHMOND, VIRGINIA 23236 • 804-794-2500  
FAX 804-794-8284

Circle (47) on Fast Fact Card



# Catch the winning spirit.

From the forge of world-wide competition comes the new Hustler *Spirit* series of vertical antennas.

Designed to win the race to provide the highest performance and durability possible, at a price that leaves others in the dust.

If you are driven to achieve a superior signal; if you need an antenna which is virtually impervious to wind and weather; if you want the best the world has to offer, catch our new *Spirit*-and win today.

*Model Shown: HS9-45070*

*Also Available: Models from 136 MHz. to 2 GHz, including Land Mobile, Cellular, Trunking, SMR, Paging and PCN. All models available in a variety of gain configurations.*



**Beyond your Expectations**

One Newtronics Place  
Mineral Wells, Texas 76067  
1-800-949-9490 • (817) 325-1386

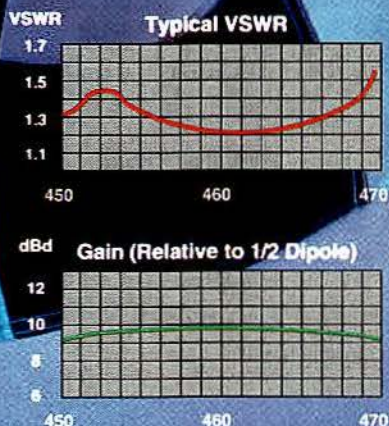
YES, I'm interested in the new *Spirit*.  
Please send me your latest Professional  
Products catalog.

Name

Company

Address

City  State  Zip



Circle (48) on Fast Fact Card



## Expo

KG 309 ultra-compact eight-channel, 5W portable.  
**Circle 360**

**Landmark Tower** **Booths 1058, 1060**  
*Existing products*  
Landmark type I, II, III self-support towers; SkyPod tower-constructed equipment shelter; conventional self-support and guyed towers; tower leasing and management services.  
**Circle 361**

**Lease Acceptance** **Booth 1062**  
*Existing products*  
Lease and financial information.  
**Circle 362**

**David Levy** **Booth 4105**  
*Existing products*  
Terminals; fuses; cable ties; wire; test equipment; connectors; pager cases; security systems for vehicles; relays; speakers; tools; technical support videos and books.  
*New products*  
Black Widow BW-800 smart system—pager vehicle security system; ProLink high amperage installation accessories; 1st source hardware installation kits.  
**Circle 363**

**Marconi Instruments** **Booth 8037**  
*Existing products*  
2957 series cellular radio test set; 2965 radio test set; CMA 2032 antenna signal processor; 2051 digital and vector signal generator.  
*New products*  
2945 communications service monitor.  
**Circle 364**

**Marktronics** **Booth 6007**  
*Existing products*  
JRC SUD-404 single-channel radiotelephone; Radius M120, P110; Midland 70-1336 mobile; Andrew and Celwave foam dielectric cable and connectors; Astron and Newmar power supplies; Antennex and ASP mobile antennas; Bird wattmeter; Motorola pagers—Memo Express, Advisor.  
*New products*  
ETrunk boards for low-cost trunking system; SP50 Motorola Radius portable; 70-147 and 70-148 Midland portables; Megapage on-site paging scheduler and controller.  
**Circle 365** **See ad page 92**

**Maxon America** **Booth 4041**  
*Existing products*  
SP-2000 synthesized handheld with scan—UHF/VHF; SM-4000 synthesized mobile—UHF/VHF; CP-0500 crystallized handheld—UHF/VHF; TP-4800 trunking handheld—800MHz; TR-4800 trunking mobile—800MHz; SP-5050 HD synthesized handheld—25MHz to 50MHz; DM-0500 telemetry/data radios—UHF/VHF.  
**Circle 366** **See ad page 29**

**Maxrad** **Booth 8060**  
*Existing products*  
Antennas for land mobile, cellular, marine and base station applications; mobile, marine and base station mounting hardware; related accessory products.  
*New products*  
BMAF series glass-mount antennas; BMAG

series very small magnetic mounts.  
**Circle 367** **See ad page 91**

**Mentor Engineering** **Booth 1079**  
*Existing products*  
Express mobile data terminals for two-way wireless data communications over UHF, VHF, 800MHz/900MHz trunked (SMR) and public data networks—automatic vehicle location, mobile printers, passenger ID verification, odometer monitoring and card readers are all supported.  
**Circle 368**

**Meridian Communications** **Booth 9009**  
*Existing products*  
43+ antenna sites in Southern California; antenna site management services and techniques.  
*New products*  
Antenna site in downtown Los Angeles; Frazier Mountain antenna site connecting the San Joaquin Valley and the Los Angeles basin.  
**Circle 369** **See ad page 55, classifieds**

**Microspace Communications** **Booth 1111**  
*Existing products*  
Analog and digital satellite channels for the paging industry; customized, multivendor solutions to paging companies' transmission requirements.  
**Circle 370**

**Microwave Data Systems** **Booth 1080**  
*Existing products*  
400MHz and 900MHz point-to-point voice and data radios; 400MHz and 900MHz point-to-multipoint voice and data radios; 900MHz spread-spectrum data radios.  
**Circle 371**

**Microwave Tower Service** **Booth 3106**  
*Existing products*  
Antenna mounting hardware and components; coaxial cable mounting hardware and components.  
**Circle 372**

**Midian Electronics** **Booth 1000**  
*Existing products*  
Universal encoder/decoder boards; boxes; mics; scramblers; station identifiers; ANI; radiotelephone trunking products; paging; CAD systems; tone/digital squelch products; remote control systems; scramblers for the Maxon SP2000/SL70.  
*New products*  
RTI-800 interconnect; trunking module for GP300; radiotelephone handset.  
**Circle 373** **See ad page 32F**

**Midland Land Mobile Radio** **Booth 3035**  
*Existing products*  
70-000 series Syn-Tech XTR and Syn-Tech II mobile radios; 70-000 series Syn-Tech XTR desktop radios and accessories; 70-000 series Midland portable radios and accessories; 71-000 series Base-Tech repeaters and base stations and options.  
*New products*  
70-148 VHF wideband portable radio; 70-248 UHF wideband portable radio; 70-147 VHF wideband portable radio; 70-9405 LTR-compatible/conventional portable radio.  
**Circle 374**

**Milcom International** **Booth 3074**  
*Existing products*

300W paging transmitter; SMR power amplifiers.  
*New products*  
MCA 8000-250 multichannel amplifier.  
**Circle 375**

**John Mitchell** **Booth 7048**  
*Existing products*  
Software: Radiopac total SMR management system, which interfaces with selected accounting packages; multilingual billing formats.  
**Circle 376**

**Mobile Mark** **Booths 2059, 2061, 2063**  
*Existing products*  
Land mobile, cellular, PCS and ISM antennas: Mini-Mark cellular glass-mount; RM series mobile antennas; CV series VHF/UHF base stations; OW series glass-mount VHF/UHF antennas; DH14 series PCS antennas.  
*New products*

New antennas for PCS and ISM applications, including SCR corner reflector for PCS; SH series single helix for PCS; OD series omni-base stations for cellular and PCS; RTP series body-mount antennas for PCS; PS rubber duck antennas for PCS; new antennas for 220MHz band operation.  
**Circle 377** **See ad page 26**

**Mobile Radio Technology** **Booth 8019**  
*Existing products*  
*Mobile Radio Technology* is recognized as the leading source of technology-focused industry guidance. Readers include mobile radio dealers and service shops, large-volume end-users at public safety, government, transportation, business and industrial agencies, as well as paging and SMR service providers, and manufacturers and their reps and distributors. The editorial addresses the latest in equipment and applications, business developments, legal and regulatory matters. Visit our booth to pick up a copy and sign up for your free subscription.  
**Circle 378**

**Modular Communication Systems** **Booth 8091**  
*Existing products*  
Ultra-Com Pro microprocessor-based communications control system, including proprietary Screenmaker and Customizer programs.  
**Circle 379** **See ad page 21**

**Monark International** **Booth 7090**  
*Existing products*  
Monark, Signet UHF synthesized portables; Monark Cp-ter VHF and UHF synthesized portables; Pantech PS-100 VHF Superslim, synthesized portables; Pantech PT-103, PT-105, PT-905 VHF and 900MHz numeric display pagers; Telson TSP-ISIN VHF numeric display pager.  
*New products*  
Pantech American PS-100 VHF Superslim synthesized portable; Pantech American PT-103 VHF numeric display pager (top display); Pantech American PT-105 VHF numeric display pager (side display); Pantech American PT-905 900MHz numeric display pager (side display); Telson America TSP-ISIN VHF, UHF display pager (top display).  
**Circle 380**

**Motorola** **Booth 3075**  
*Existing products*



# Why Tinker Around When it Comes to Your Communications Testing



## THE NEW IFR 1200

# SUPER-S

### A New Breakthrough In Analog Service Monitors

Now, the ease of use found in analog service monitors is combined with some of the best features available in the new digital instruments. IFR presents the new 1200 SUPER-S, providing to you the best of both worlds. Its incredible features such as storage of 99 RF frequencies, direct channel selection for cellular, trunking and cordless telephones, easier programming of 2-tone and 5/6-tone signaling, duplex offset frequencies up to  $\pm 49.9975$  MHz and cable fault location with the optional tracking generator make the 1200 Super-S a highly versatile instrument.

Of course, the Super-S still provides all the standard features previously found in the FM/AM-1200S such as analog and digital meters for convenient operation regardless of the lighting conditions, 1 GHz RF generator, 1 kHz and variable frequency audio generators, duplex operation, 2  $\mu$ V receiver, 150 W

power meter, 1 GHz spectrum analyzer, 1 MHz oscilloscope and RS-232 interface.

The list of options is as impressive as the new features. Options such as European analog signaling, tracking generator with cable fault, CLEARCHANNEL LTR®, AMPS cellular and ETACS cellular are available at time of delivery or may be retrofitted at a later date by IFR's customer service department.

If you require high quality communications service monitors to install or maintain systems for trunking, paging, land mobile or cellular and you provide field service as well as in-shop service, then contact IFR Systems at 1-800-835-2352 for a demonstration.



**IFR SYSTEMS, INC.**



10200 West York Street / Wichita, Kansas 67215-8935 U.S.A.  
Phone 316/522-4981 / 1-800-835-2352 / FAX 316/522-1360



## Expo

R-2660 MIRS communications system analyzer;  
R-2670 communications system analyzer for  
trunking/Astro; R-2600 communications system  
analyzer.

### New products

TDMA 1000 communications system analyzer  
for TDMA testing; Micro RF isolator—portable  
screen room.

Circle 381

See ad page 5

### Multiplier Industries

Booth 8025

### Existing products

Batteries and accessories for two-way radios

and cellular phones.

### New products

Motorola Radius GP300 battery—Multiplier part  
#M9628; Motorola Saber radio intrinsically safe  
battery—Multiplier part #M4596.

Circle 382

### MX-Com

Booth 5043

### Existing products

Pvt Squelch voice inversion privacy adapter;  
Cypher-MX variable split band rolling code  
scrambler.

### New products

CADi ANI radio fleet call manager system.

Circle 383

See ad page 7

### Natcom

Booth 2063

### Existing products

Sales and distribution of pager products; pager  
repair.

Circle 384

See ad pages 63, classifieds

### Newmar

Booth 2103

### Existing products

Power products, including power supplies, bat-  
tery chargers, dc-dc converters and power rack  
products for 12Vdc, 24Vdc, or 48Vdc systems;  
accessories.

### New products

HS series Hot Swap redundant power system; IPS  
integrated power system; rack power supply with  
built-in battery backup.

Circle 385

See ad page 92

### NorComm

Booths 3057, 3059

### Existing products

Data signaling encoders/decoders for CTCSS;  
two-tone sequential; DTMF; digital coded  
squelch; single tone burst; notch and bandpass  
filters; 1,500Hz/2,805Hz digital.

### New products

NC400 DTMF computer-aided dispatching con-  
sole; NC801 micro-miniature inversion scrambler  
for intermediate-level security for two-way radio  
voice communication systems; NC4000 multi-  
mode DTMF encoder/decoder.

Circle 386

See ad page 78

### Northpoint Communication

Booth 5102

### Products

### Existing products

LoPro mobile antennas for UHF, cellular and  
SMR trunking applications; low-profile mobile  
antennas— $\frac{5}{8}$ " high with 3dB gain.

### New products

LoPro NP4020 UHF antenna, 410MHz–  
424MHz; LoPro NP4025 UHF antenna,  
417MHz–435MHz; Lo Pro NP4065 UHF an-  
tenna, 455MHz–475MHz; Lo Pro NP4080 UHF  
antenna, 466MHz–488MHz.

Circle 387

### Nutel Electronics

Booth 5050

### Existing products

8000 Comm-Pak 960MHz and 2GHz point-to-  
point microwave radio; 9000 Skyline 2GHz  
point-to-point microwave radio; 9500 Skytrax  
frequency division voice multiplex.

Circle 388

### OptaPhone Systems

Booth 2075

### New products

2000 point-to-point and point-to-multipoint rural  
radio telephone systems.

Circle 389

### Orbacom Systems

Booth 1048

### New products

TDM-150 series distributed microprocessor;  
communications control consoles—modular and  
CRT; Calida+ desktop 16-channel user-program-  
mable console.

Circle 390


See ad page 57

### Pace

Booth 1068

### Existing products

SensaTemp modular systems for assembly and




# Radius®

## PORTABLES, MOBILES BASE STATIONS REPEATERS

We've earned a good  
Radius business with a  
large inventory, good  
prices and quick service.  
We would like to earn  
your business . . .  
please call today.

TOLL-FREE (800) 877-7979

## HENRY RADIO



2050 South Bundy Drive  
Los Angeles, CA 90025

Phone (310) 820-1234  
FAX 310-826-7790

Circle (50) on Fast Fact Card

Does your Portable computer or MDT need **Sunglasses**????



Call **MOUNTING SOLUTIONS** for Information at 1-800-MOUNT-14.

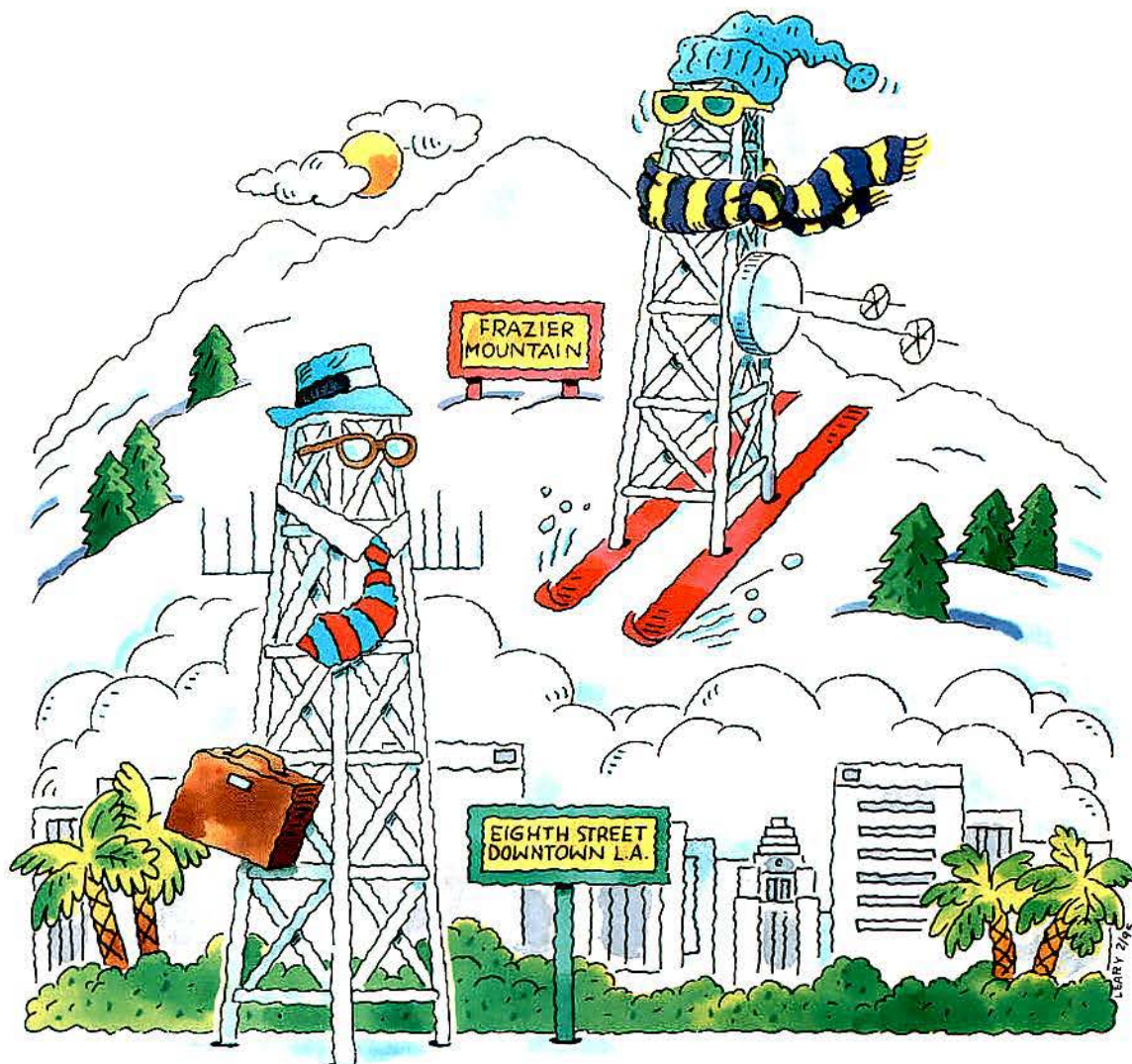
Mounting Solutions, Inc. is a  
manufacturer of mounting hardware and  
accessories for portable computers and  
other equipment used by the mobile  
workforce.



900 Grossman Dr. Scherfield, WI 54476

Circle (51) on Fast Fact Card





# From Eighth Street to 8,000 feet, our two new sites were worth the wait.

For optimum coverage of downtown Los Angeles, our new site atop the Eighth Street Building provides peak performance. And for coverage that reaches into the San Joaquin Valley, our new site on Frazier Mountain is without parallel.

These key antenna sites add to our existing portfolio of sites that range from the Mexican border to Santa Maria. And, of course, we're continually adding new sites.

When it comes to our extensive offering of site features, ours is second to none. For example, we are installing continuous site monitoring to keep track of temperature, electricity status and other critical variables. Our state-of-the-art facilities include a number of other important features such as a new high-security access system, stand-by power, air conditioning and comprehensive site maintenance.

And while it was worth waiting for these two new antenna sites, you'll *never* have to wait for excellent and attentive service from Jack and Rich Reichler. To locate your equipment at our sites or for more information and your free Pocket Site Selector and Organizer, call (800)400-SITE. **Great sites, great service, since 1956.**



**FREE!**

Packed with valuable info and California sites.



## Meridian Communications

23501 Park Sorrento, Suite 213A, Calabasas, CA 91302-1355  
(818) 222-5655 • (800) 400-SITE (7483) • Fax (818) 222-2857



repair, including the ST 40 and ST 20 Sodr-Pen stations; MBT 250 microprocessor-controlled SMT/Thru-Hole assembly and rework system; MBT 201, MBT 101 self-contained soldering and desoldering systems; training programs—on-site classroom instruction, videos.

#### New products

ST 60 Auto/Snap-Vac desoldering station; ST 20-TT ThermoTweez SMT station; ThermoBond CirKits for modification and repair of SMT and Thru-Hole circuitry; Craft BGA system.

Circle 391

#### Pacific Crest

##### Existing products

Multichannel modems for point-to-point and point-to-multipoint applications; telemetry radios; RF power amplifiers for data communication; antennas; cables; connectors.

##### New products

RFM96 family of high-speed synthesized radio modems; RFA96 RF power amplifiers with standard solid-state relays; UHF telemetry modules.

Circle 392

Booth 9057

#### Page-Com

##### Existing products

Motorola Radius portable; Motorola Sitemate paging system; Maxon SP2000 series portables.

Circle 393

Booth 9090

#### Panavise Products

##### Existing products

Slimline mounts; Slimline 2000 mount; Portagrip phone holder; Stay-put flex mounts; Uni-flex mounts; mobile data terminal mounts (Solo, Express and Premier series); standard series mounts; radio mounts.

##### New products

In-dash mounts specifically designed for every vehicle.

Circle 394

Booth 6064

#### Photocomm

##### Existing products

Solar electric systems and components.

##### New products

Cellpak wireless power system; portable Sun Pak; Solavolt SV7500, SV8500 solar electric modules.

Circle 395

See ad page 85

Booth 4069

#### Pico Communications

##### Existing products

DTMF encoder; DTMF ANI ENI.

Circle 396

See ad page 83

Booth 1030

#### PolyPhaser

##### Existing products

Coaxial protector series (RF/data/LAN/video) for GPS/cellular/paging; wire pairs protector series (data/LAN/Telco/analog/digital); power lines (ac and dc/plug-in/hardware); grounding equipment and systems.

##### New products

IS-CS50HN coax protector with sampler port.

Circle 397

See ad page 24

Booth 7017

#### Power Conversion Products

##### Existing products

PS-23 rectifiers; PS-19 rectifiers.

##### New products

TwinPack Plus ac-to-dc modular rectifiers; Power Node dc power plant with Nema 3R enclosure.

Circle 398

Booth 9080

#### RadioMate

##### Existing products

Headsets and audio accessories for use with two-way radios, including portables, mobiles, base/control stations and remotes.

##### New products

SwitchMate II audio switching device that houses most brands of mobiles and converts to a base/control station.

Circle 399

See ad page 93

Booth 8091

#### Ranger Communications

##### Existing products

UHF and VHF portable radios; mobile radios; base station/repeaters; digital paging transmitters; mobile repeaters; rural telephone systems.

##### New products

RCI-7100 16-channel synthesized hand-held radio; RCI-1700 16-channel synthesized mobile radio.

Circle 400

Booth 1013

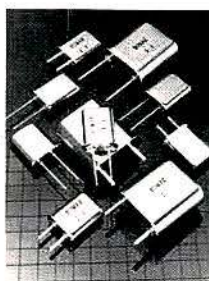
#### Relm Communications

##### Existing products

Two-way FM crystal and synthesized mobile.

Booth 4003

# "Paging Bomar Crystals!"



Bomar answers your call for excellence with high performance crystals designed for today's leading tone/voice

and digital/numeric pagers. Our rugged pager crystals are engineered to deliver superior performance. Performance that comes from over twenty-five years of experience. And performance backed by a lifetime guarantee. Call now for page after page of useful information about our quality products...delivered to you on the double!

## BOMAR

201 Blackford Avenue, Middlesex, N.J. 08846

CALL TOLL FREE  
1-800-526-3935

FAX TOLL FREE  
1-800-777-2197

Circle (53) on Fast Fact Card



ANNOUNCING

ERICSSON



Ericsson GE Mobile Communications Inc.  
Mountain View Road · Lynchburg, Virginia 24502

EDACS™

Trunking Licensee

# When every second counts...



TDM-150: Our state-of-the-art, 120+ channel console

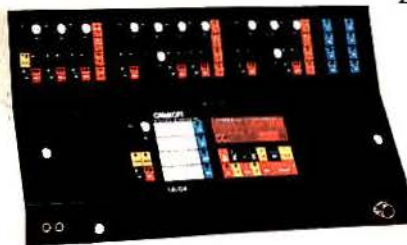
## Count on the reliability and performance of communications consoles from Orbakom

In an emergency, reliable communications are the lifeline for survival. That's why so many communications systems rely on Orbakom's CALIDA and TDM-150 consoles. Their superior performance and solid dependability have been proven in the most demanding applications.

If you need the control flexibility of a big console on a small budget, CALIDA is for you. CALIDA handles 16 channels, includes a multi-format paging and signalling encoder, is completely user programmable, and features a 12/24 hour clock, VU meter, alert tone, crosspatch, service intercom, desk mic with PTT and monitor switches, surge protection, and a wealth of other professional features.

If your service requires a state-of-the-art dispatch console, Orbakom's TDM-150 is the solution. TDM-150 is a custom system, so we'll configure it the way you need it — up to 120 channels or more and 120 positions. TDM-150 uses time-

division multiplex (TDM) digital audio processing and complete microprocessor control. Operation is simple and menu-driven. Reliability is ensured through surge protection, self-healing diagnostics, and battery backup. Eight levels of multi-channel radio and telephone patch may be run simultaneously, and an internal paging signalling encoder generates any sequence you'll ever need. Plus the best two-year console warranty in the business.



CALIDA: Big console flexibility for smaller systems



Mini-TDM-150 Desktop Console

Take your pick. CALIDA for professional performance in smaller systems. And TDM-150 for state-of-the-art performance on 120 channels or more. Either way you can count on Orbakom. Our communications consoles are the most reliable you can buy, and have been since 1970.

Call (609) 829-4455  
and let Orbakom solve your  
dispatching problems. Orbakom  
Systems, Inc., 1704 Taylors Lane,  
Cinnaminson, NJ 08077;  
FAX: (609) 829-6980.



**ORBAKOM  
SYSTEMS, INC.**

Circle (54) on Fast Fact Card



## Expo

portable and base radios; repeaters; base station components and subsystems; multiplexed antenna systems and IM suppression products.

**Circle 401**

**See ad IBC**

### RF Industries

**Booth 6047**

#### Existing products

Coaxial connectors, including BNC, TNC, UHF, MB and SMA; corrugated cable connectors; cable assemblies; crimping kits; universal Unadapt adapter products.

#### New products

RFA-4026 Celludapt cellular technician's kit;

RFA-4007 steel ratching crimp tool kit; RFA-4089 miniature pin crimping tool for coax and D-subminiature crimp pins.

**Circle 402**

### RF Technology

**Booth 9086**

#### New products

Eclipse series base/repeaters and links.

**Circle 403**

### Ritron

**Booth 4063**

#### New products

RRX-450 synthesized repeater; SST sub-

miniature handheld.

**Circle 404**

**See ad page 59**

### Rohn

**Booth 1047**

#### Existing products

Self-supporting towers; guyed towers; steel poles; concrete poles; fiberglass equipment shelters; concrete equipment shelters; tower obstruction lights; safety climbing devices; tower hardware.

**Circle 405**

### Ropex

**Booth 4087**

#### Existing products

Peiker microphones; Peiker handsets; Professional line of car phone accessories.

#### New products

Peiker PS30 desktop microphone; Brodit Plast's Professional car phone holder.

**Circle 406**

### Ruf-Nek Building Company

**Booth 5063**

#### Existing products

Fiberglass and concrete shelters fully equipped to support electronic equipment and associated services.

**Circle 407**

### Sabre Communications

**Booth 2074**

#### Existing products

Guyed and self-supporting towers.

#### New products

V.A.M.S. vertically adjustable mounting system.

**Circle 408**

**See classified ads**

### Samlex America

**Booths 9021, 9023**

#### Existing products

Regulated dc power supply; dc-dc converters; CB radio accessories; dc-ac inverters; on-line voltage regulators.

#### New products

FC-1000 cellular telephone power supply/charger; FC-500 cellular telephone charger; CB radio SWR; CB radio match box; CB radio amplifier.

**Circle 409**

### Scala Electronic

**Booth 6015**

#### Existing products

Panel antennas for cellular and trunking; Americell line of panel antennas; Omni antennas for trunking, cellular, narrowband PCS and communications.

#### New products

Americell PCS/PCN antennas; mobile tester used for installation to test output power, VSWR and measure voltage/impedance.

**Circle 410**

### SEA

**Booth 3047**

#### Existing products

ESP504 220MHz mobile transceiver; ESP520 220MHz mobile transceiver; ESP1000 220MHz repeater/base station.

#### New products

700 portable handheld; transceiver for 220MHz-222MHz.

**Circle 411**

### Selectone

**Booth 3069**

#### Existing products

Smartrunk II digital trunking system; Data Messenger mobile data system; voice encryption products; ANI and tone signaling.

#### New products



## Quality Wireless Communication Products Supported By The Longest Warranty In The Industry

The EP series pagers are small and light but still packed with features!

- Standard AAA (included)
- Vibration or Tone Alert
- Date and Clock Display
- Alarm
- 20 Message 400 Character Memory
- One Button Operation
- Message Time Stamping
- Message Protection (Password)
- Selective Message Delete
- Two Level Alert Tone
- Automatic Illumination
- Automatic Reset
- Out of Range Indicator
- Low Battery Alert
- Detachable Belt Clip
- Full Memory Indication
- Unread Message Indication
- Mail Drop (if applicable with service provider)

**EVERON**  
AMERICA, INC.

IBM Building, Suite 180  
6360 I-55 No. Frontage Rd.  
Jackson, Mississippi 39211  
(800) 603-3766  
(601) 952-2400

Circle (55) on Fast Fact Card



# You Say You Want A Revolution.



America is asking for a radical change. Some are even suggesting a revolution. A return to the basics. Where decisions are based on common sense and fact.

And the fact is, you owe it to yourself to look into the Patriot story. Not only is Ritron the best, small, 2-way radio company in the world today, but our Patriot line has become America's marketshare sweetheart. If it were an oil well, it would be a gusher.

And like all Patriot radios, it's priced to earn you, THE DEALER, a high profit. By anyone's definition, the Patriot has been a tremendous success for our dealers. Not only has the Patriot line grown to meet the demands of more and more customers,

but as a result, has become the high quality, low cost industry leader.

The word about Patriot is spreading. Like any company with rocketing marketshare, we're looking to further expand our numbers. A limited number of Patriot dealerships are still available.

If you'd like to know more about the growing ranks of Patriot, call us at 1-800-USA-1-USA or FAX (317) 846-4978.

The Revolution begins...

**PATRIOT**  
BY RITRON

Circle (56) on Fast Fact Card





## Expo

Smarttrunk II applications and features; new voice encryption.  
**Circle 412**

### Setcom **Booth 3061**

*Existing products*  
Headsets; police motorcycle helmet comkits; SCBA comkits for use with both portable and mobile radios; vehicular intercom/radio mixer systems.

*New products*  
PK series police motorcycle helmet comkit; System 1300EMS intercom/radio mixer system for EMS vehicles; PIM series pump panel interface module for structural fire engines.  
**Circle 413**

### Sharp Communications **Booth 2097**

*Existing products*  
GE mobile radios; Telewave site management equipment; Samlex power supplies; Whelen safety and warning signals; RFI connectors.  
**Circle 414** **See classified ads**

### Shinwa Communications of America **Booth 7047**

*Existing products*  
Checkmate IV tone and voice pager; SDP digital pager; STAT series mobile and portable radios; GII series portable radios; X series lowband mobile.

*New products*  
Base station/repeater; in-house paging system.  
**Circle 415**

### Shure Brothers **Booth 9042**

*Existing products*  
590T Modulink microphone; 592T noise canceling Modulink microphone; 885TT DTMF Modulink microphone; 888TT aircraft DTMF Modulink microphone; ALM series of replacement Modulink cordsets for many popular transceivers.

*New products*  
596LB hand-held microphone; 550T base station Modulink microphone; ALM cordsets for Ericsson Orion and MDX series of radios; ALM cordset for E.F. Johnson Summit radio line.  
**Circle 416** **See ad page 47**

### Sinclair Technologies **Booth 5037**

*Existing products*  
PCS/GSM series antennas; 220MHz combining system; cellular combiners; cellular/paging antennas.

*New products*  
Sinclabs mobile antenna line; Sinclabs A1022 148MHz-174MHz antenna.  
**Circle 417**

### Skaggs Telecommunications **Booth 4090**

*Existing products*  
Rack console; electronic equipment.  
**Circle 418**

### Slattery Software **Booth 2065**

*Existing products*  
FCC licensing software; price quotation software.

*New products*

Quickform 600 software for the computer generation of FCC Form 600.  
**Circle 419** **See classified ads**

### SMC Electro-Mount **Booth 8068**

*Existing products*  
S2000 series mounting systems; VFM series flex mounts; Uni-lok series pedestal mounts.

*New products*  
SMC 9QCB-1 seat mount bracket; SMC DashPro line of dash-mount brackets; SMC VMA-LO laptop computer mounting system.  
**Circle 420** **See ad page 86**

### SoftWright **Booth 9066**

*Existing products*  
Terrain Analysis Package (TAP).

*New products*  
SiteBase for Windows; TAP version 3.1.  
**Circle 421** **See classified ads**

### Solar Electric Specialties **Booths 8081, 8083**

*Existing products*  
MAPPS stand-alone solar electric power systems; Photogenset hybrid solar electric/genset power systems; Solar/Cell-Sealed, maintenance-free deep cycle batteries; BETRSolar rural telephone solar power system.

*New products*  
Solar/Cell 6SC210 sealed AGM deep cycle battery; SR-50 photovoltaic module; 2-4X/24 photovoltaic control center; Prostar 12-30 photovoltaic system charge regulators.  
**Circle 422** **See ad page 36**

## SOMETHING THIS GOOD COULD ONLY GET BETTER!

We've gone from **GOOD** to **BETTER** with our new RXR Series Base Station/Repeater Package

### RX Series Base Station/Repeater Amplifier Package\*



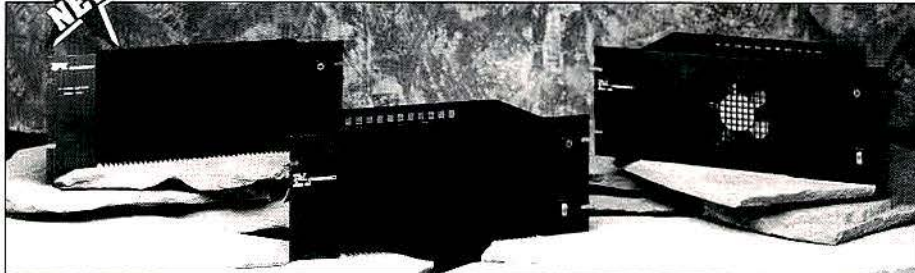
**Good**

TPL introduces the latest innovation in reliable, cost effective, continuous duty power amplifiers. This Series incorporates all the features of the very popular RX Series but in a lighter, more modern package. This package will accept any TPL amplifier up to 120 watts, low band through 960 MHz. It can be provided with or without a cooling fan. Both configurations are designed with a flush front, allowing for installation into a cabinet, leaving sufficient room for air flow with the door closed.

\*Replaced by RXR Series



### RXR Series Base Station/Repeater Amplifier Package



**Better**

The amplifier has the fuse and off/on switch conveniently located on the front panel. It can be supplied with or without a DC power supply.

The RXR Series is the most versatile unit of its type on the market today, and it comes from the leader in power amplifiers for over 23 years. TPL is so confident with the new RXR Series that they'll cover it with a **new 2 year warranty.**

Front panel fuse & off/on switch.

Flat front panel allows for cabinet door closure.  
19" W x 7" H x 7" D. (9" deep with fan and power supply options)

Leadership by tradition

**TPL**  
COMMUNICATIONS

3370 San Fernando Rd., Unit 206  
Los Angeles, CA 90065  
Tel: (213) 256-3000  
(800) HI POWER  
Fax: (213) 254-3210

Circle (57) on Fast Fact Card



# At Microflect, when it comes to cellular towers... We don't just install, We do it *all*.

Finding a company that integrates engineering design, fabrication, installation and after-sales service makes sense. With Microflect as a partner in your project from start to finish, you benefit from our unique, insider's view and experience. We respond quickly and effectively, and, when needed, provide follow-up support via phone or on-site.

## Serving the Cellular Industry - From Concept to Reality

While others may farm out a significant portion of your project, Microflect does it all - in house. Our engineers take an innovative approach to design challenges, and consistently provide the quality, value and performance our clients have come to expect from Microflect. Our expert fabrication and on-site installation professionals do the same. So whatever your needs, we're with you, every step of the way.

## After-Sales Service That Endures

Microflect's reputation for after-sales service wouldn't be possible without the highly qualified, dedicated individuals who are always just a phone call away. It's been said that our service never stops. And it's true. Our commitment to you endures, just as our products do. Because Microflect's cellular towers are all born under one roof, we take great pride in each installation, and in each and every component. That pride shows with every call our company receives, with every design challenge we meet, and with every cellular tower installation that bears the Microflect name.

## Put us to work for you.

Put our proven, integrated approach for cellular communications to work for you. At Microflect, we truly do it all. All under one roof. And just a phone call away.



Serving the Communications Industry since 1956.

Call today for your Cellular Tower solutions.

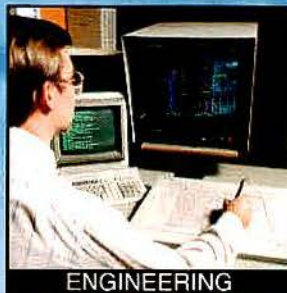
**1-800-547-2151**

Ask for extension 870

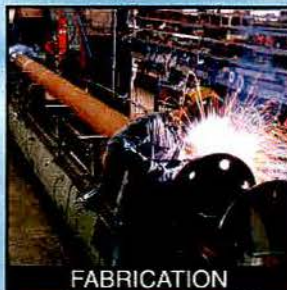
FAX (503) 363-4613

3575 25th St. SE • Salem, OR 97302-1190

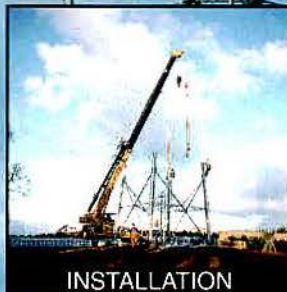
Circle (58) on Fast Fact Card



ENGINEERING



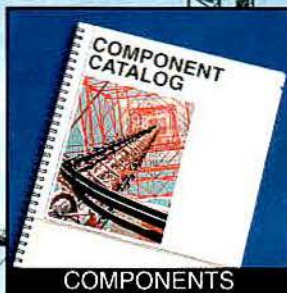
FABRICATION



INSTALLATION



TECHNICAL SERVICES



COMPONENTS



**Towers**  
• Self-Supporting • Guyed

**Custom  
Structures**

**Field  
Services**

**Components**

**Passive  
Repeaters**



## Expo

### Sonic Communications Booths 2083, 2085

#### Existing products

Two-way radio communication accessories, such as headsets; ear-mics; throat-mics; motor-cycle/auto-racing equipment; two- and three-wire covert surveillance kits.

Circle 423

See ad page 12

### SpaceCom Systems Booth 1090

#### Existing products

M2000A satellite receiver; M2000X satellite receiver; M2000AP satellite receiver.

#### New products

M2000B satellite receiver.

Circle 424

### Spectrum Communications Booth 7069

#### Existing products

Conventional and simulcast paging transmitters (VHF, UHF, 280MHz and 900MHz); repeaters; RF link transmitters and receivers; high-power amps; link controllers; hot standby transmitter systems.

#### New products

SS10,000 Ultra-high stability (simulcast) generator.

Circle 425

See ad page 88

### Stancil Booth 3102

#### Existing products

Centurion digital voice logging recorders; DBR/VHS recorders; IR solid-state instant recall recorders.

#### New products

Centurion 64-track DAT 24-hour voice recorder. Circle 426

### Standard Communications Booth 1043

#### Existing products

Conventional and trunked two-way radios, including portables, mobiles, base stations, repeaters and related accessories.

#### New products

HX381 VHF/UHF 16-channel, 5W portable; GX5810T+ dash-mount, dual-protocol 800MHz trunked mobile; GX5800 full-featured, 10-character alphanumeric display 800MHz trunked mobile. Circle 427

### Sti-Co Booth 7061

#### Existing products

Disguised mobile two-way antennas, including custom cowl mount lowband, highband, UHF and broadband models; cellular look-alike VHF, UHF and dualband antennas; low profile transit antennas; couplers; tuners; dual-matched systems.

#### New products

800 series (XXX-S-800) custom cowl mount disguised two-way antennas cover cellular and trunking frequency ranges and are exact AM/FM antenna replacements for select Ford, Chrysler and GM body styles. Optional AM/FM broadcast couplers available.

Circle 428

See ad page 40

### Survey Technologies Booth 7115

#### Existing products

STI-9000.

#### New products

STI-9100.

Circle 429

### Tad Radio of Canada Booth 9047

#### Existing products

M8 VHF and UHF wideband mobile; MD150 and MD450 VHF and UHF cadet mobiles.

Circle 430

### Tait Electronics Booth 6063

#### Existing products

T-800 series repeaters; T-800 series paging transmitters; T-800 base stations; T-800 Slimline series; T-801 Quasi-sync base.

#### New products

T-2000 series mobiles; T-3000 series portables.

Circle 431

See classified ads

### Talley Communications booth 8009

#### Existing products

Offers more than 100 manufacturers' products and value-added services, including cut-to-length cable; connectors; antennas; test equipment.

Circle 432

See ad page 62

### TCC Industries Booth 1075

#### Existing products

Coaxial connectors, including, "N," mini-UHF, BNC, TNC, RCA, UHF, SMA, F; rotating nipple; battery eliminator; plug-in saver and charger; lead acid battery; conditioner/rapid charger; flip phone holder; crimping and

## Your Communications Solution for



### A/S Mobile & A/S-Decibel Base Station Systems Equipment

- Filter Tuning & Retuning
- Antennas & Accessories
- Engineering Customer Support
- Combiner, Duplexers & Cavities
- Tower Top Amplifiers, Rx Multicouplers
- Talley Will Stage Your System for On Time Delivery

800-949-7079



Los Angeles • Phoenix • San Diego • San Francisco  
International: 310-949-7005

Circle (59) on Fast Fact Card

## How much of your money is tied up in warranty & RMA's ?

Let's face it, warranty management has become a much more complicated issue than it was five years ago. Fortunately, ServicePlus accurately tracks warranty claims and RMA's by integrating and managing all administrative and decision support functions throughout the service cycle.

From a single point of entry (Logbook), you can access accurate work order data, equipment history, customers, suppliers, technicians, service contracts, inventory and dispatch information. ServicePlus manages the work order from initial service call to final invoicing.

#### ServicePlus modules include:

- SP Manager
- Logbook (Work Orders/Invoicing)
- Inventory Control
- Service Contracts
- Dispatch
- Purchase Orders
- ACCPAC Plus™, Great Plains™ or SBT™ Accounting Interface

ServicePlus  
Service Information System

Series 2

Hottest Price/  
Performance  
in its class!

**\$2780**

Buys you a network capable system including:  
SP Manager, Logbook, Inventory Control and Service Contracts.



ServiceWare Corporation  
Tel: (613) 521-7391  
Fax: (613) 521-5595

Circle (60) on Fast Fact Card



# **NATCOM, INC./ KERN PAGER REPAIR**

## *Your One Stop Pager Shop*



- New Pagers
- Refurbished Pagers
- Pager Repair

Get the best of both worlds with Natcom and Kern Pager Repair. Our qualified technicians have the experience needed to keep your pagers on the street and profits in your pocket.

Our sales staff can provide you with new pagers or quality refurbished pagers with quick delivery.

*Our expectations are yours. Call us and experience the difference.*

 **NATCOM**  
I N C O R P O R A T E D

834 Foley Street  
Jackson, MS 39202  
800-844-5376

 **KERN** Pager Repair

5422 Carrier Drive, Ste. 205  
Orlando, FL 32819  
800-345-6067



stripping tools; pedestal mount; dashboard mount; hands-free system.

## New products

Ultimate hands-free system; integrated hands-free system; ear/mic hands-free system.

Circle 433

## Tekk

Booth 4109

## Existing products

T-80 synthesized VHF 10-channel portable; T-20/40 series VHF/UHF portables, one- and two-channel, 2W; T-50/60 series VHF/UHF 5W/4W, four- and two-channel portables; PCI

and TS-200 series portables.

## New products

CP-150 12-character numeric POCSAG pager with calculator; TP-450 UHF in-house tone/vibrate pager; MP-150 VHF miniature numeric pager; MP-450 UHF miniature numeric pager.

Circle 434

## Tektronix

Booth 9088

## Existing products

Wireless test products: CMS54 Radiocomm service monitors; U4941 portable spectrum analyzers; SMY economy RF signal generators; URV

RF power meters.

## New products

R3272 microwave spectrum analyzer.

Circle 435

## Telephonics

Booth 1081

## Existing products

Sure-Comm product line of radios, headsets, chargers and accessories.

## New products

Sure-Comm's new 'base station.'

Circle 436

## Telepoint

Booth 8078

## Existing products

RTL-1000 and RTX-2000 radio links.

## New products

SR-20 synthesized radio telephone link.

Circle 437

## Telewave

Booth 2091

## Existing products

Transmitter combiners; monitoring and test equipment; High Q cavities and filters; collinear antennas; receiver multicouplers; ferrite devices and terminations; duplexers; dipole antennas; yagi antennas.

## New products

M101-220 five-channel 220MHz trunking combiner; Tylan-coated dipole and yagi antennas.

Circle 438

## Telex Communications

Booth 8028

## Existing products

EM-200 Ear-Mike; EM-300 Ear-Mike; EC-100 security Ear-Mike; Magnacom emergency vehicle intercom system; MagnaRope confined space intercom; headsets for mobile and portable two-way radios.

## New products

NH9000 tactical/military/industrial headset; earsets; in-the-ear receivers for two-way radios.

Circle 439

## Tessco

Booth 3065

## Existing products

Infrastructure products; mobile and portable radio/phone accessories; base and mobile antennas; bench equipment; tools and shop supplies; test and measurement equipment.

## New products

1995 Buyers' Guide.

Circle 440

See ad page 45

## Times Microwave Systems

Booth 9043

## Existing products

LMR series low-loss coaxial cables, connectors and assemblies; nu-TRAC triaxial antenna cable.

## New products

LMR-900 5/8" cable; EZ600-NMH connector; LMR-240 UltraFlex; LMR-400 UltraFlex.

Circle 441

See ad page 68

## Tower Structures

Booth 9074

## Existing products

Design, engineer, fabricate and install towers; shelters; monopoles.

## New products

Quick Pole.

Circle 442

## TowerWatch

Booth 6102

## Existing products

Tower light monitoring service to provide regulatory compliance for monitoring, logging and

## 61st APCO Conference & Exposition August 13 - 17, 1995 COBO Conference/Exhibition Center Detroit, Michigan

The APCO Conference and Exposition is the world's largest gathering of public safety communications professionals including:

- 9-1-1 Centers
- Fire Departments
- Public Safety Departments
- Forestry
- Military
- Technical & Repair
- Consultants
- Law Enforcement Agencies
- Emergency Medical Services
- Transportation Agencies & Facilities
- Colleges and Universities
- Manufacturers
- Engineers
- Many, many others

### The 61st APCO Conference & Exposition offers the attendee:

- An opportunity to explore the many facets of public safety telecommunications.
- Exhibits of more than 250 companies displaying state-of-the-art communications equipment, products and services
- Extensive educational opportunities through seminars addressing areas including Management & Planning, Telecommunicator Training, 9-1-1, Information Systems and Technology
- Extensive networking and learning opportunities
  - Training classes designed to provide classroom presentation methods, training strategies, alternative training methods and other topics

No matter your involvement in the public safety community, you will benefit from Communications In Motion, the 61st APCO Conference and Exposition.

## Communications In Motion

For Exhibit and attendee information call 800/949-2726 for  
Keri Burns-Molyneaux, ext. 226 or Pat Daniels, ext. 249

APCO is in accordance with ADA requirements and will provide reasonable accommodations for full conference participants upon notification. Please consult the registration form in the attendee package.



recordkeeping of tower lights. Service provides equipment and monitoring to report 11 states on lighting, electrical and phone systems on towers.  
**New products**  
DSC-16 unit for light systems with alarm contacts; SLS-16 unit for light systems without alarm contacts.  
**Circle 443** See classified ads

**TPI Communications** Booth 1008  
**Existing products**  
RF power amplifiers, 35MHz-960MHz—input levels 1mW, output to 500W; mobile, base station and repeater models with or without power supplies.  
**New products**  
RXR series base station/repeater continuous-duty power amplifier with self-contained power supply.  
**Circle 444** See ad page 60

**Transcrypt International** Booth 6057  
**Existing products**  
CVP (Crypto-Voice-Plus) series scramblers; continuous synchronization system scramblers; international scramblers; TransPulse (mobile computer); status modules; status control products.  
**New products**  
MicroTac cellular scrambler; DME-9600 dual-mode encryptor.  
**Circle 445** See ad page 3

**Trident Micro Systems** Booth 7043  
**Existing products**  
LTR trunking controllers; call routers; voice mail; mobile data products.  
**New products**  
M-12 data modem; MC-242 two- to four-wire modem converter.  
**Circle 446**

**Trilogy Communications** Booth 6110  
**Existing products**  
AirCell radiating coaxial cables and connectors; MC<sup>2</sup> 50Ω and 75Ω transmission lines; air dielectric coaxial cables.  
**Circle 447** See ad page 15

**Triplett** Booth 2076  
**Existing products**  
5000E portable analog cellular test set.  
**New products**  
6000 TDMA digital/analog portable cellular test set; Isolator 144 portable RF isolation test chamber; 5505 capacitance meter and glass capacitance probe.  
**Circle 448**

**TWR Telecom/TWR Lighting** Booth 1057  
**Existing products**  
Tower engineering; tower construction capabilities; tower lighting; communications equipment sales; and installation services.  
**Circle 449**

**Tx Rx Systems** Booth 5019  
**Existing products**  
Signal booster systems; multicouplers; duplexers; resonant cavity filters; RF system products and associated hardware.  
**Circle 450**

**Uniden America** Booth 1003  
**New products**

SPS801, SPS802 trunking portables; SPU454, SPH155 conventional portables; SVS8035 trunking mobile; SMU4525, SMH1525 conventional mobiles; SRU450, SRH150 conventional repeaters; ARX3105 ESAS.  
**Circle 451**

**United States Testing** Booth 9107  
**Existing products**  
Independent testing laboratory providing compliance testing services; EMI-RFI-FCC; product safety; intrinsic safety testing.  
**Circle 452**

**US Tower** Booth 9098  
**Existing products**  
Mobile tower trailer units; crank-up tubular and triangular towers.  
**New products**  
Working model of a tower trailer unit.  
**Circle 453**

**Valmont Industries** Booth 1066  
**Existing products**  
Tapered, tubular, steel monopoles up to 250'; guyed towers up to 800'; self-supporting lattice towers up to 400'; platform mounts; arm configurations; installation services.  
**New products**  
"Camouflage" cell sites; tree poles; church poles; sign poles.  
**Circle 454** See ad page 44

**VCP Communications** Booth 1087  
**New products**  
XLT Alpha; Panasonic 2H.  
**Circle 455**

**Vega** Booths 1026, 1028  
**Existing products**  
5000 series 10-line, four-frequency radio control consoles; C-1614 six-line, four-frequency tone-remote console; C-535 three-line dc-remote control console; 1223C/1224 tone-remote adapter cards for installing in telco shelves.  
**New products**  
System modules that mount in telco shelves, such as summing line driver, two-way audio line driver with speaker amplifier and multiple-relay card.  
**Circle 456** See ad page 1

**Vertex/Yaesu** Booth 7009  
**Existing products**  
Two-way portable and mobile radios, including the VX-500 series of portables and the FTH-207 commercial dualband (VHF/UHF) portable.  
**Circle 457**

**W&W Associates** Booth 8015  
**Existing products**  
Replacement batteries for two-way radios, pocket pagers, cellular phones and laptops; chargers for two-way radios.  
**New products**  
Replacement batteries for Kenwood TK250/350, Reim WHS150, Kyodo West KG-109, Motorola P-110; chargers for two-way radios; MasterCharger I, Iia, I+I, I+Iia, and Iia + Iia.  
**Circle 458** See ad page 32A

**Wacom Products** Booth 3058  
**Existing products**  
Cavity filters; duplexers; ferrite isolators; transmitter combiners; receiver multicoupler systems.  
**New products**

Combiners; high-power cavity filters.  
**Circle 459**

**Wavetek** Booth 5065  
**Existing products**  
4015S communications service monitor; 4032 communications analog/digital test set; 3600D cellular subscriber test set; 600 CAT cellular activation tester; paging/low-cost service monitor, model 2100/300.  
**New products**  
PCS communications test set, 4032 DCS 1800.  
**Circle 460** See ad page 17

**Western Multiplex** Booth 8089  
**Existing products**  
Lynx E1 (2.048Mbps) spread-spectrum wireless.  
**New products**  
WM4T6 (4 x 1.544Mbps) 6GHz digital radio; Lynx 6 (1.544Mbps) spread-spectrum wireless.  
**Circle 461**

**Willmar Technical College** Booth TBA  
**Existing products**  
Information on how communications companies can hire trained RF technicians, graduated from Willmar Tech.; information on applying for training at Willmar.  
**Circle 462**

**WirelessWorld magazine** Booth 8019  
**Existing products**  
Published bi-monthly. *WirelessWorld* provides market updates, engineering information, applications stories and the latest news of the wireless communications industry—particularly emerging and newly competitive technologies such as broadband and narrowband PCS, paging, E-SMR and satellite. Readers include PCS licensees and applicants, operators of cellular, paging and E-SMR systems, as well as CATV system operators, inter- and local-exchange carriers and large-volume end-users, LAN/MIS managers, systems integrators, manufacturers and their reps and distributors. The 1995 WirelessWorld Expo will be held in San Francisco on Nov. 7-9. Call 800-458-0479 to attend.  
**Circle 463**

**Z-Technology** Booth 7115  
**New products**  
R-505 field strength meter; AA 2 log periodic calibrated antenna system; DD-2 data logging software.  
**Circle 464**

**Zetron** Booth 5025  
**Existing products**  
Microphones; paging encoders; interconnects; tone panels and repeater controllers; recall recorders; paging terminals; alarm monitor/control systems; fire station alerting system; paging system components; consoles; trunking products; digital switches; rural telephony; modular dispatch/PSAP; digital hybrids; wide-area voice/data systems; billing software.  
**New products**  
1550 SentiMax; 1519 AlphaAlert; 1804 FastLink; ULTRAc+ alarm/monitor/control system; 59 status tracker; series 4000 EDACS wireless console.  
**Circle 465** See ad pages 32E, 75, 84





# Servicing pagers: Essential differences

*Part 14—Here are some tips for programming Bravo Plus and Bravo Express pagers, including computer and storage media selection, hardware connections and software installation.*

By David Ludvigson

Unlike the Bravo pager, the Bravo Plus and Bravo Express pagers are capable of more than merely receiving pages and displaying basic information in the window. One big difference is a 12/24-hour clock with a time stamp. The clock and time stamp features (although not essential to pager operation) provide something for the microprocessor to do while waiting for a paging message.

## View from the programmer

Plus and Express programming requires more sophistication than the Bravo. In this case, the user will need an IBM-compatible computer with at least 360K of resident RAM (user supplied) and the programming interface and software (provided by Motorola). The necessary hardware and software are packaged under Motorola part number NLN 3548B. The NLN 3640A includes diskettes for the Bravo Plus and the necessary interfacing hardware to match the pager to be programmed. Similarly, the NLN 3723A package contains software and a test fixture to mate with the Bravo Express.

The NLN 3548B requires the use of one of the RS-232 serial ports found at the rear of the computer, defined by the user in the SETUP program when saved to hard disk or diskette. It is suggested that the default names be used to access the program, i.e., BRAVOPPS for Bravo Plus, and BREXPPPS for the Bravo Express.

Depending on what is connected to your computer, it may be convenient to use COM PORT 1 for a printer and COM PORT 2 for the programmer. In this manner, PGRFILES (or any other bookkeeping utility program) will not collide on

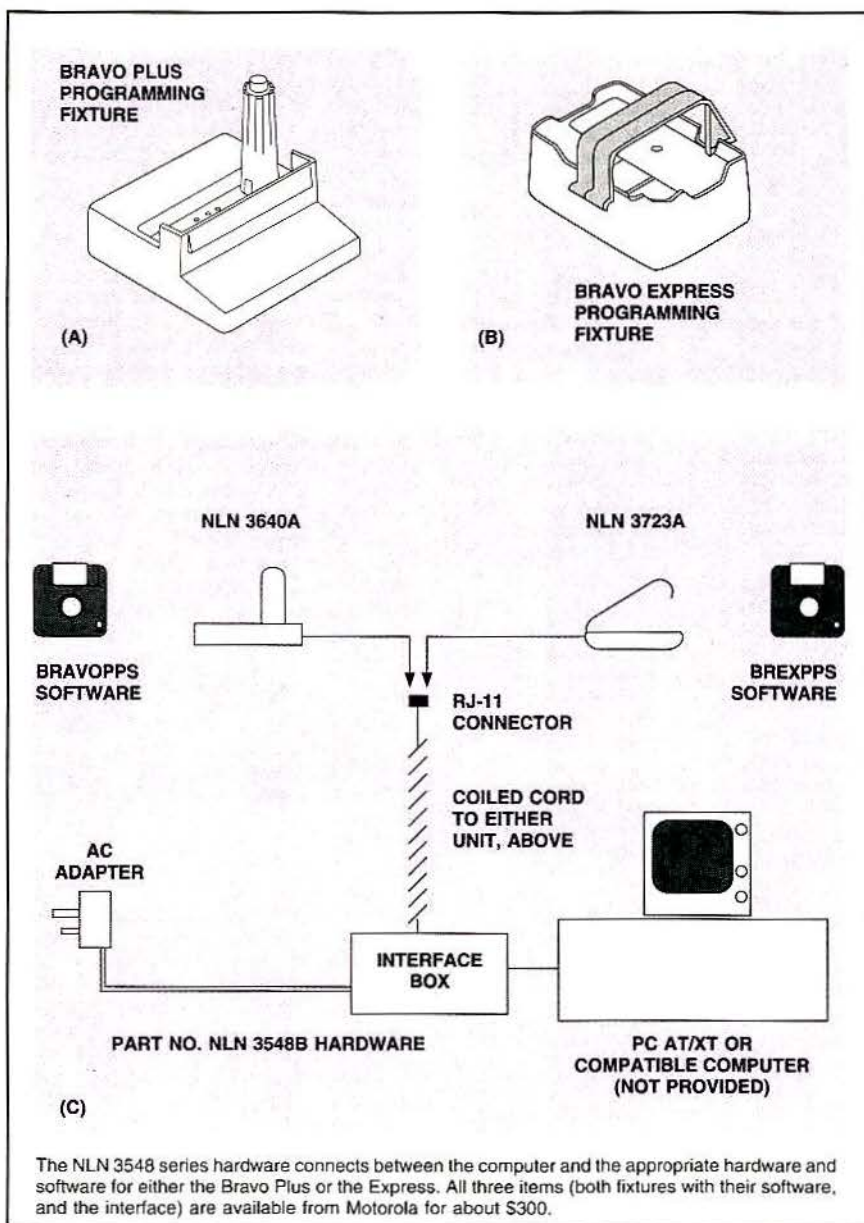
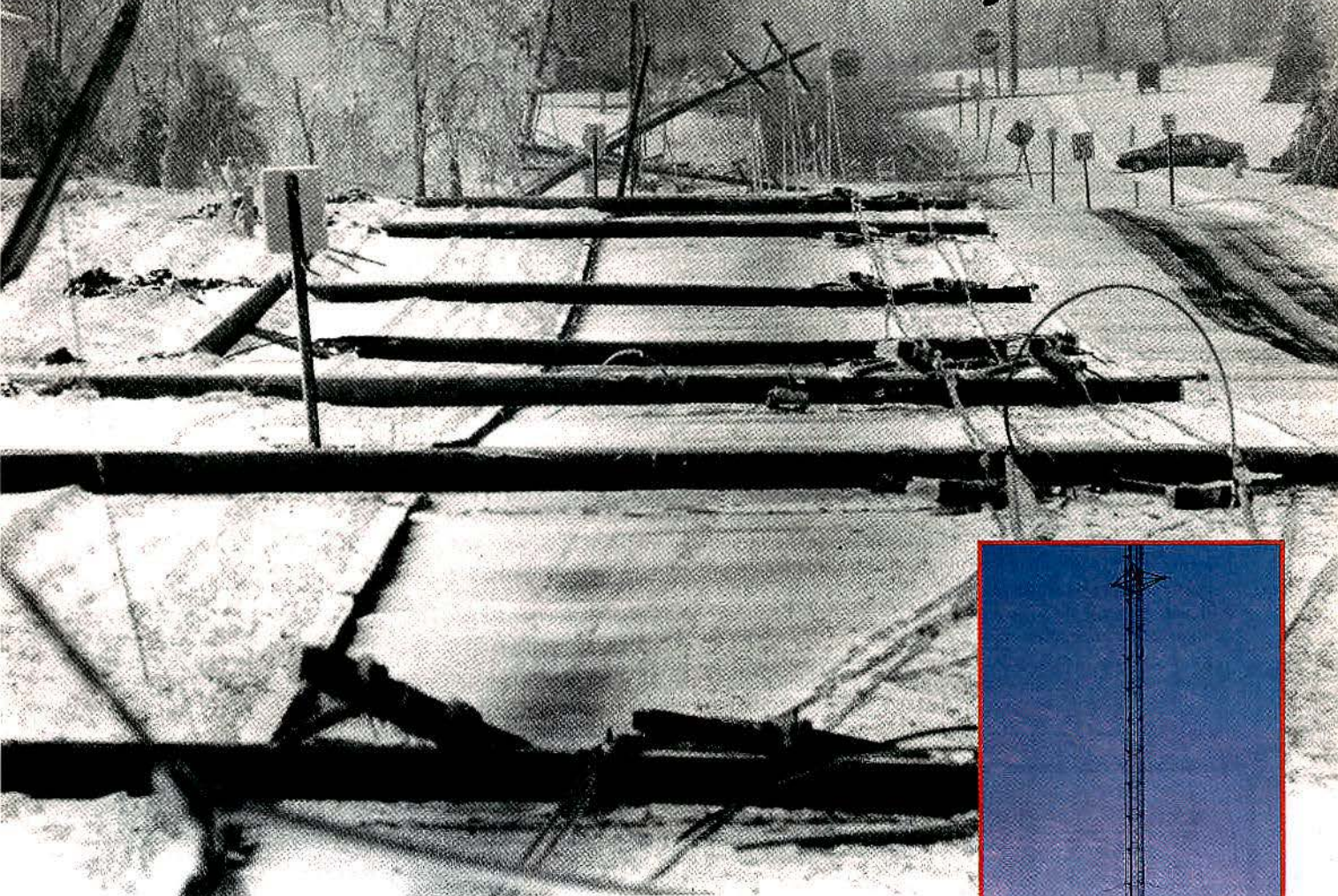


Figure 1: Programming fixtures are used to hold the Bravo Plus (A) and Bravo Express (B) pagers. The equipment configuration is shown at (C).

Ludvigson is a technician in Houston.



# WHEN THE ICE CAME,



## OUR PiROD TOWER DIDN'T EVEN SHIVER.



**Dave Turner**  
WMCC TV, Channel 23  
Indianapolis, Indiana

"With more than two feet of ice at the antenna of our 1,000-foot PiRod tower, and guy wire ice eight inches in diameter, our tower bent like a banana. I recall my engineer saying that the tower wouldn't last five more minutes. But our solid rod PiRod tower stood there and straightened as the ice melted. No damage. No stress fractures. No problems. I guess that's when the quality of a solid rod PiRod tower comes through."

*Solid Rod, Solid Service, Solid Value*



*Solid rod, free-standing or  
guyed towers custom designed  
to your specifications.*

For a free guide to tower selection  
and fast, courteous response to your  
requests for quotation, contact:



**PiROD INC.**

P.O. Box 128  
Plymouth, Indiana 46563-0128  
Telephone (219) 936-4221



the RS-232 lines. (PGRFILES was covered in Part 12 in the January 1995 issue.)

There is one quirk with the Bravo Plus and Bravo Express software. The Bravo Plus software runs well at 33MHz; both reading FROM and writing TO the Bravo Plus may be done at Turbo speed. Programming the Express, though, requires defeating the Turbo feature of most high-speed computers. The software can READ the pager fine at Turbo speeds, but WRITING to the Express requires a slower speed. Motorola has a software remedy for this problem, available for the asking.

Software protection is an option in these programs. Passwords can be placed in front of the main body of the program, preventing unauthorized use. Similarly, a password may be embedded in either the Plus or Express to prevent others from reading or overwriting the data you have entered. As you will discover, there are 10 spaces in the ENTER PAGER PASSWORD frame. Each space may be filled with any letter, number or some punctuation marks. Because there are 26 letters, 10 digits and numerous punctuation marks, the possibility of exactly matching an unknown string is exceedingly remote—and you only get

six or seven attempts to do so! Unofficial (non-Motorola) hardware and software adaptations have been developed that allow the user to defeat the password protection. Password-removal equipment may be purchased from Viamtel, 2909 Fannin, Houston, TX 77002, 713-750-0007.

#### Hardware connections

An ac adapter provides the required operating voltages for the interface unit. Attached by means of RJ-11 connectors, a mechanical interface consisting of a 3-pin electrical connector and a form-fitting pager nest provides the terminals for communicating data to and from the pager. (See Figure 1 on page 66.) The mechanical interface is changed to match either the Bravo Plus or the Express.

#### Software installation: Bravo Plus

Provided with the NLN 3640A are the necessary diskettes (both 5¼-inch and 3½-inch) that turn the computer into a programmer.

Bring up the drive-prompt (A>). Insert the proper diskette into the A drive. Verify the drive by typing A: and hit ENTER. Behind the A prompt, type SETUP and hit

ENTER. Copyright and version number will be displayed along with a "hit any key to continue" message. Doing so will bring up a selection screen where you decide whether you will be using backup floppy copies of the software or installing it on a hard drive.

---

*... a password may be embedded in either the Plus or Express to prevent others from reading or overwriting the data you have entered.*

---

Assuming use of the hard drive, merely hit ENTER or RETURN after reading the first page of the SETUP program. Page two asks for verification of the destination drive for the program. Is it the hard drive?

# The Kink Is Dead.

Working with corrugated cable can be a royal pain. It kinks. It's not flexible. It can cost you time and money.

LMR Coaxial Cable won't kink. So, your system installs much easier, and you'll save money. You'll get the optimum performance you expect, with comparable loss.

You'll find it in a size just right for your next installation. Call:

**1-800-TMS-COAX**

for a distributor near you.

**Long Live LMR.  
The No Kink Cable.**



**TIMES**  
MICROWAVE SYSTEMS  
P.O. Box 5039, Wallingford, CT 06492  
(203) 949-8400 • FAX: (203) 949-8423



©TIMES MICROWAVE SYSTEMS 1994



Circle (65) on Fast Fact Card



# "We need to respond to emergencies at a moments notice."



*"Response time is everything. When every second counts, you have to be able to rely on your two-way equipment to give you constant, immediate communications."*

*There isn't time to put up with inferior equipment prone to breakdown. That's why choosing Kenwood 2-way radios, with their reputation for dependability and quality service, was an easy call to make. En route to a medical emergency, we rely on our 2-way communications to maintain contact with the hospital and dispatch. The better our communications, the better the chance we'll be able to save a life."*

## **CALL 1-800-950-5005**

Get a free pocket-sized screwdriver set with a dealer demonstration.\* Call 1-800-950-5005 for a Kenwood Representative nearest you.

**TEAM UP WITH KENWOOD**



*\*while supplies last*

**TEAM 2 WAY™**  
**KENWOOD**

P.O. Box 22745, Long Beach, CA 90801-5745 • (310) 639-4200 or fax (310) 761-8246

For information on our complete turn-key trunking systems, contact Kenwood Systems Group at 1-800-TRUNKING

The TK-630, 730, 830 Series mobiles can be customized for many applications, including dual band and dual head configurations. And unlike other radios requiring expensive add-ons, the TK-630, 730, 830 Series come with these standard features:

- ❖ Built in Public Address
- ❖ Backlit LCD and Buttons
- ❖ Assignable Buttons
- ❖ Speaker Control
- ❖ 12 Character Alphanumeric Capability
- ❖ Single or Dual Priority Scan
- ❖ Home Channel
- ❖ Talk Around
- ❖ and many others...

The TK-230SP and 330SP portables have been engineered to sustain the most rigorous demands of the public safety professional. These advanced generation VHF/UHF synthesized portables are produced with rigid adherence to the highest quality control standards, and come with these standard features:

- ❖ Microprocessor Controlled Scan
- ❖ Synthesized 100 Channel Capability
- ❖ Alphanumeric, Multifunction LCD Display
- ❖ Built-In QT and Digital QT
- ❖ Five-Watt RF Output
- ❖ MIL-STD 810 Approved
- ❖ Wide Band Frequency Spread

The TK-250/350 portables are our new rugged, compact, versatile and affordable radios. Contact your Kenwood Representative for details.





If you answer YES, the program will prompt for PATHS and PATHNAMES for your program. Because the program is on the A drive and you wish to place it on the hard drive (usually "C"), your source drive is A and the destination drive is the C drive.

The BRAVOPPS.EXE file will start on the C drive, so the program path will originate on C:. The archive files (BPLUSARK) and help files (BPLUSHLP) are "child" files called by BRAVOPPS.EXE. Unless you know how to use paths and pathnames, I suggest simply hitting ENTER when the default names are highlighted—it is easier that way, and the names are odd enough to avoid accidental over-writes.

Next, the COM PORT is selected. As mentioned earlier, I use COM PORT 1 for my printer, so COM PORT 2 is assigned for the interface. It should be noted that resident software for fax or modems might occupy various COM PORTS, so someone who *knows* might be helpful in determining what is available and how to get to it.

Ok, password time . . . (sigh!) If you are paranoid, enter your magic password in the blank. If not, leave it blank. (Mega-sigh!) The password will prevent unauthorized use of your computer as a means of programming Bravo Plus pagers.

#### No hard drive?

If you have no hard drive, get into your DOS version of DISKCOPY and make copies of both disk 1 and disk 2, labeling them appropriately.

Enter the SETUP program by answering N to the "Is this setup correct?" question at the bottom of the screen. Place your *copy* of disk 1 in the B drive and

your *copy* of disk 2 in the A drive.

At the DISK #1 DRIVE prompt, enter B. At the DISK #2 DRIVE prompt, enter A. Hit the ENTER key as the default paths are highlighted, and select your COM PORT and PASSWORD as outlined above. If you have followed these directions, or if you are content with your choices, answer Y to the query at the bottom of the screen. The drives will grind for a few seconds as the appropriate files

are marked and transferred from one to the other.

Starting the diskette version of BRAVOPPS will require placing the *copy* of disk 2 in drive A and the *copy* of disk 1 in drive B. At the A> prompt, enter BRAVOPPS. Unless you have protected your program with a password, the Motorola copyright notice and "hit any key. . ." message will appear. If the program has been password-protected, you

## Crystal suppliers

David Ludvigson's January 1995 article included a reference to a supplier for crystals that can be used in the Motorola Bravo pager. In response to a request, here is a list of additional suppliers for such pager crystals. Circle the corresponding number on the Fast Fact Card on page 117 to receive information from any supplier. Addresses, telephone numbers and fax numbers for these suppliers are printed in the December 1994 edition's buyers' guide section.

Adams Distributing

Circle (225) on Fast Fact card

Bomar

Circle (226) on Fast Fact card

Cal Crystal Lab

Circle (227) on Fast Fact card

D&L Wholesale Distribution

Circle (228) on Fast Fact card

Electro Dynamics Crystal

Circle (229) on Fast Fact card

Frequency Management

Circle (230) on Fast Fact card

Hite Electronic Sales

Circle (231) on Fast Fact card

Hy-Q International

Circle (232) on Fast Fact card

ICM Communications

Circle (233) on Fast Fact card

K-W Manufacturing

Circle (234) on Fast Fact card

Marden Electronics

Circle (235) on Fast Fact card

Motorola

Circle (236) on Fast Fact card

Sentry Manufacturing

Circle (237) on Fast Fact card

## E - X - T - E - N - D YOUR EXISTING RF COVERAGE

### USE:

Patented signal taps  
On Frequency Radio Repeaters  
Booster amplifiers, Line amplifiers . . .

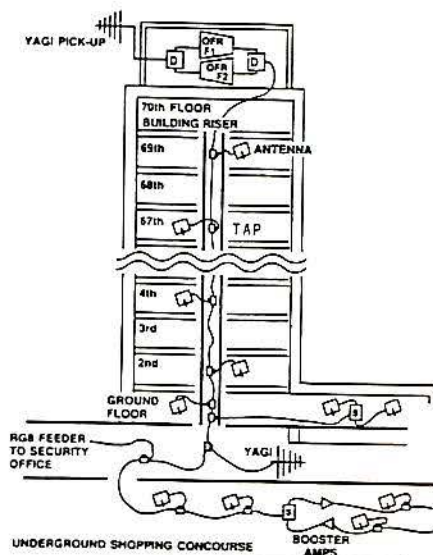
and the

**EXPERIENCE OF THE COMPANY**  
that specializes in RF extension systems

# KAVAL

ELECTRONICS INC.

1637 Brentwood Crossing, Conyers, GA 30208 (404) 918-9750 fax (404) 918-9749  
401 Alden Road, Unit 11, Markham, ON L3R 4N4 (905) 940-1400 fax (905) 940-1402



Circle (67) on Fast Fact Card



# WE'RE COMING THRU LOUD & CLEAR



## AV10 Motorola 2 Way-Radio

- Power Output: 1 Watt
- VHF Frequency Band
- BLUE DOT (154.570 MHz)
- 4 Dealer Selectable Channels Available
- Talk Range: 1-4 Miles
- Rechargeable Battery
- 10 Hr. Charging Adapter
- Removable Belt Clip
- Manufactured in the U.S.A.

Circle (68) on Fast Fact Card

## AV11 Motorola 2 Way-Radio

- Same Features as Model AV10, But is More Compact and Has an Audio Jack to Add Optional Accessories.

## AV11C Motorola 2 Way-Radio

- Same Features as Model AV11, But Also Has CODED SQUELCH: to Eliminate Other "Business Chatter" While Unit is on Standby.

FOR MORE INFORMATION PLEASE  
CALL 1-800-726-2333

**PANA-PACIFIC**  
C O R P O R A T I O N



# TONE PANEL WAR

Call Ray Dashner today  
at **800-545-1349**  
for blowout Tone Panel  
pricing!



**H**ere are some of the reasons our TP-154 is your best choice...

- Lowest Price.
- 50 CTCSS Tones.
- 104 DCS Codes.
- Front Panel Display.
- CTCSS TRACK™ gives best sensitivity
- Unbeatable performance.
- More programability than any other panel.
- And more!

**IMMEDIATE DELIVERY  
ONE YEAR WARRANTY**

Made in U.S.A.

*Sale subject to withdrawal and  
only available in U.S.A.*



2259 Portola Rd. Ventura, Ca 93003  
Phone (805) 642-7184 Fax (805) 642-7271

Toll-free **800-545-1349**

## Pager servicing series

Part 1: "Build a Shielded Room," January 1994. (All pagers.)

Part 2: "Build An 'IFFER,'" February 1994. (Bravo, Bravo Plus, Bravo Express.)

Part 3: "Frequencies, Coding Formats," March 1994. (Bravo.)

Part 4: "From Bench To Programmer," April 1994. (Bravo.)

Part 5: "The Receivers," May 1994. (Bravo.)

Part 6: "Elegant Simplicity," June 1994. (Bravo.)

Part 7: "Problems In Paradise," July 1994. (Bravo.)

Part 8: "406MHz-512MHz Receivers," August 1994. (Bravo.)

Part 9: "150MHz Receivers," September 1994. (Bravo.)

Part 10: "Tales Crystal Filters Tell ...," October 1994. (Bravo, Bravo Plus, Bravo Express.)

Part 11: "Microprocessor Board," November 1994. (Bravo.)

Part 12: "Headaches (and some aspirin)," January 1995. (Bravo.)

Part 13: "Mixed Signals," February 1995. (Bravo.)

Part 14: "Essential Differences," April 1995. (Bravo Plus, Bravo Express.)

Back issues printed within the past two years can be ordered for \$5 each, postpaid. Call customer service at 800-441-0294. Issues printed more than two years ago and individual article photocopies are unavailable from the publisher.

will have to enter your password before the program will let you in.

Similarly, starting BRAVOPPS from the hard drive will require entering BRAVOPPS at the C> prompt. Enter your password, if required, and you will be at the copyright notice.

## Software installation: Bravo Express

In general, installation of the Bravo Express software is identical to that of the Plus.

With the SETUP diskette in drive A, type *SETUP* behind the A> prompt. The same options as presented above will appear on the screen, allowing you to exit and make copies using DOS DISKCOPY or proceed to install the programs on your hard drive. You will be prompted for your COM PORTS and PASSWORD. If the Bravo Plus software works well, enter the same COM PORT as you used previously. As noted earlier, diskette working copies will end up with diskette copy 1 in drive B and diskette copy 2 in drive A. The use of default paths and pathnames is encouraged.

Having successfully installed the software, type *BREXPPPS* at the drive prompt and hit *ENTER*. Enter your password (if used) and begin programming the Bravo Express.

## Acknowledgement

I would like to thank the management and staff of JJ Sounds & Communications, South Houston, TX, for their help with this project. Tel: 713-944-1813.



## ISOLATORS - CIRCULATORS - LOADS

TRANSMITTER COMBINERS

**EMR corp.**

Economical High Performance Duplexers



Model 64534/EH  
Frequency Range: 134-174 MHz  
Insertion Loss: 1.2 dB @ 3 MHz Spacing  
Isolation: 80+ dB @ 5 MHz Spacing  
Input Power: 100 Watts  
Dimensions: 5.25" x 19" x 6.625"  
List Price: \$ 535.00

Contact the factory for our complete product information and our series of technical articles on antenna site applications. EMR manufactures RF filters from 66 MHz to 1.3 GHz.

Model 65534/EH  
Frequency Range: 406-512 MHz  
Insertion Loss: 1.1 dB @ 5 MHz Spacing  
Isolation: 80+ dB @ 5 MHz Spacing  
Input Power: 100 Watts  
Dimensions: 5.25" x 19" x 6.625"  
List Price: \$ 500.00

22402 N. 19th Avenue - PHOENIX, ARIZONA 85027  
TEL: 602-581-2875 - FAX: 602-582-9499

## CAVITIES - ANTENNA DUPLEXERS

Circle (70) on Fast Fact Card

RECEIVER MULTICOUPLERS



# GETTING MAXIMUM PERFORMANCE FROM EVERY INSTALLATION

## Bird's New Antenna Tester Eliminates The Guesswork!

Installing and troubleshooting antennas for cellular phones and mobile radios can be a guessing game. Undetected problems with connectors, cabling, antenna placement — even glass characteristics — can drastically affect performance.

Bird's new AT-800 rapidly tests antennas for any 806-960 MHz analog or digital service. The AT-800 contains its own RF source and is preset for existing cellular bands. Or, select your own frequency range. A 100-point scan of VSWR, Match Efficiency, or Return Loss takes just a second, and you see the results graphically. A simulated analog meter display speeds tuning at single frequencies, and field strength mode verifies hand-helds. PASS-FAIL testing, audible indicators, and a host of other features make quick work out of being sure. Yet, for all its power and versatility, the AT-800 is remarkably easy to use.

For installers, engineers, technicians. With the AT-800, there's no reason to guess anymore. Contact Bird now for more details.

# BIRD

Electronic Corporation

U.S. Headquarters: 216-248-1200

Fax: 216-248-5426

Western U.S. Sales Office: 805-646-7255

Fax: 805-646-0275

European Sales Office: 353-61-360583

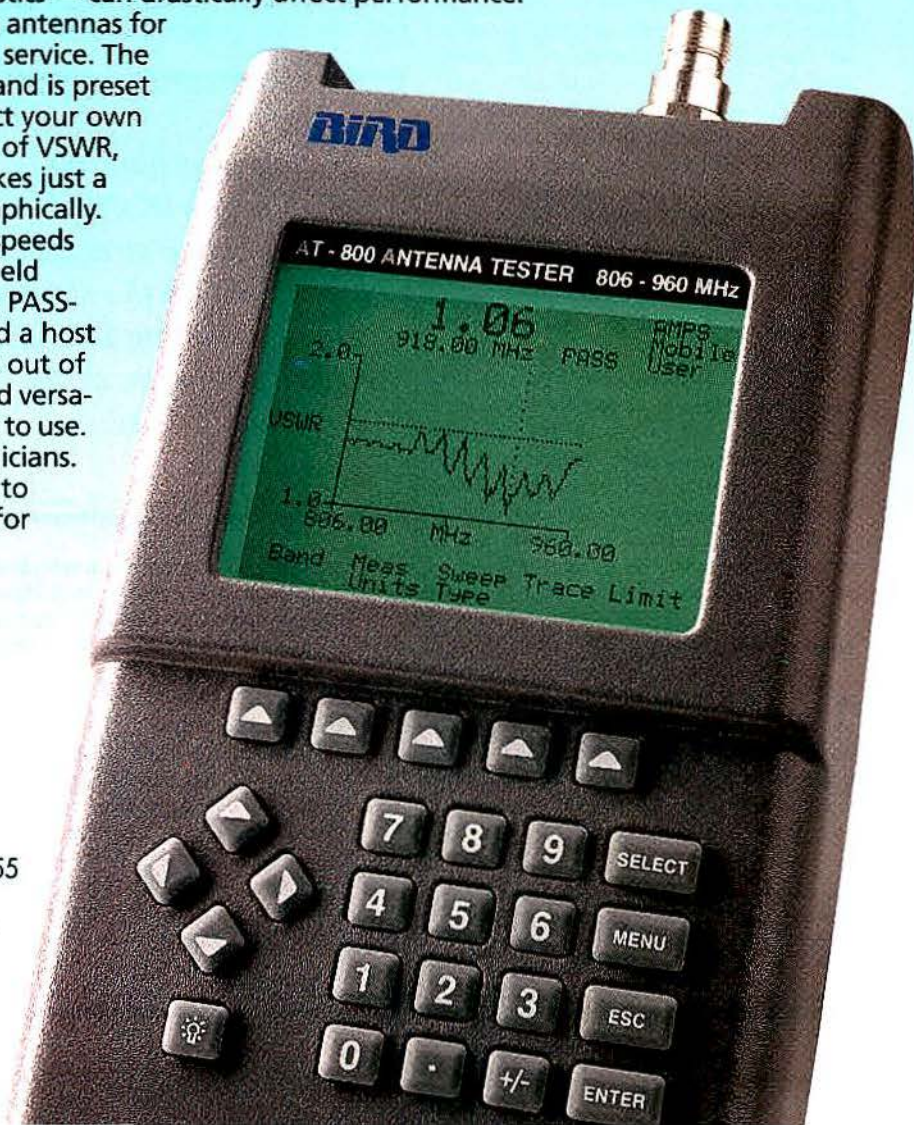
Fax: 353-61-360585

Pan-Asian Sales Office: 65-2992537

Fax: 65-2998509

Visit us at IWCE/Spring, Booth #7050.

Circle (71) on Fast Fact Card





---

# Lightning protection theory: More fuel for the debate

*A clear understanding of the operational theory of streamer-delaying products might lead the technology's opponents to take another look and to devote some of their energy to figuring out how and why it works.*

---

By Bruce A. Kaiser

---

Six years ago there raged in these pages a debate over the benefits of static dissipation as a lightning protection technology.<sup>1,2,3,4</sup> On one side were manufacturers and users that claimed static dissipation technology worked well, and on the other side were several manufacturers and users that claimed the technology could not (in theory) and did not (in practice) work at all. The proponents based their position on what they evaluated as successful experience. The opponents cited negative test results and asserted that satisfied users either had misinterpreted their results or had attributed an actual reduction in lightning damage to dissipation technology when other factors, such as grounding and bonding, were really responsible.

Large companies with sophisticated employees and managers who otherwise were generally acknowledged to be objective in their evaluation and purchasing decisions were considered by the opponents to be somehow less capable when it came to evaluating static dissipation technology. Sophisticated users were convinced the technology worked, yet others, presumably objective in motive, were equally convinced the technology could not possibly work.

## Operational theory

Why the discrepancy? One major weakness in the proponents' position that creates confusion and also contributes to the basic misunderstanding was the operational theory presented by many static dissipation device manufacturers. The theory, as expressed in both patents and promo-

tional literature, was that the devices dissipate, or "leak off," ground charge, maintaining the protected structure's electrical potential below the critical flash point of lightning. Moreover, it was claimed that the devices actually discharged any storm cloud overhead.

This cloud-discharge theory first appeared in patents issued in the late 1920s and early 1930s, and it appeared in a patent issued as recently as 1979.<sup>5</sup> Other patents and sales literature repeated the early theories, and much product design has been

---

*Various mechanisms within an electrical storm produce stratified charges within the storm cloud, resulting in an electrical charge at the cloud's base.*

---

influenced by an attempt to implement cloud discharge. Until the 1990s, there were no new theoretical advances, and as a result, no new developments in product design since the 1930s.

## Manufacturers' claims

Static dissipation technology opponents focus on certain manufacturers' claims that their products discharge storm clouds. They have gone to great lengths to prove that such discharging is not technically possible. Because it is not possible to discharge a storm cloud, they reason that static dissipation technology cannot work.

This reasoning is beside the point, though, because *static dissipation technology does not work by discharging a storm cloud charge.*

Instead, it works by *influencing the formation of lightning-completing streamers from the protected structure.*

Various mechanisms within an electrical storm produce stratified charges within the storm cloud, resulting in an electrical charge at the cloud's base. This cloud base charge induces beneath it on the earth's surface a shadow of opposite charge commonly referred to as the *ground charge*.

As the charged storm cloud moves, the corresponding ground charge moves with it on the earth's surface. When the ground charge reaches a structure, the cloud charge's attraction pulls the ground charge up onto the structure and concentrates it on and around the structure. If, before the cloud moves away, the cloud base charge concentrates enough ground charge potential on and around the structure beneath it to overcome the dielectric (the electrical insulating quality) of the intervening air, an arc, or lightning strike, occurs.

## Stepped leaders

When the dielectric of the air is nearly overcome and lightning is about to strike, the stroke begins with what are called "stepped leaders" that branch down from the cloud. These stepped leaders propagate in jumps of about 150 feet. The next set of stepped leaders propagate through the first set and jump another 150 feet, and so on toward the ground. These stepped leaders are the tendril-like branches extending down from the cloud that are visible in many photographs of lightning.

When the stepped leaders are within 500 feet or so of the ground, the electric field intensity on the ground (the ground charge) becomes so strong that objects and structures on the ground begin to break down electrically and respond by shooting off

---

Kaiser is president of Lightning Master, Clearwater, FL.



# Need a "Quote" on an Interconnect?

"After we install a Zetron interconnect, we don't have any failure problems. Zetron interconnects just keep on working."

-- Bruce Vandenbos, B&L Comm.  
Platte SD

"The service that we receive from Zetron is second to none. If every company were as good about helping us as Zetron is, it would make my job a lot easier."

-- Chris Young, West Tennessee Comm.  
Dyersburg TN

"We certainly have used a lot of interconnects over the years. I would state that, as a rule, the Zetron products work perfectly. The back-up is fabulous."

-- Roger Combs, Frontier Radio  
Las Vegas NV

"They're reliable. That's it in a nutshell. You can count on them. And the after-sales support is excellent."

-- Dave Tubergen, T&W Electronics  
Grand Rapids MI

"The customer service is excellent. I would say it's tops in the industry. The interconnects are very programmable, adaptable to customers' needs. That's why we keep using them."

-- Dennis Korkowski, Brandon Comm.  
Brandon MN

"You put them in and forget about them. We don't have any technical problems with Zetron interconnects."

-- Jim Reed, Ark Valley Comm.  
Wichita KS

## Just let us know how many you need.



### Model 30 WORLDPATCH

A low-cost, single-user interconnect.

### Model 45B Z-PATCH

A multi-user interconnect with selective signaling formats and call accounting.

### Model 35A MICROCONNECT

A highly programmable, single-user interconnect for custom installations.

### Model 48B REPEATER MANAGER

A multi-user interconnect and community tone panel and more.

### New! DEADBOLT

Zetron's phone-line surge arrester for superlative lightning protection.

# ZETRON®

Zetron, Inc. 12335 134th Ct. N.E. Redmond WA 98052 Phone: (206) 820-6363 Fax: (206) 820-7031

Circle (72) on Fast Fact Card



streamers up toward the stepped leaders. When a streamer connects with a stepped leader, the ionized path they form becomes the channel for the main lightning discharge. The other streamers and stepped leaders never mature.

For the purposes of this article, it is not important whether the cloud base charge is positive or negative. Indeed, the change can vary, and the entire process can occur in the opposite direction.

Because current technology cannot influence the formation of cloud charge, or of stepped leaders, influencing cloud-to-ground lightning requires influencing the formation of ground charge and of streamers.

#### Charge and streamer formation

To illustrate the general principle, consider the relative merits of a sharp lightning rod vs. a blunt lightning rod. Imagine a sharp rod and a blunt rod side-by-side with the axis between them perpendicular to and directly facing an oncoming electrical storm. As the ground charge reaches the two rods, the electrical potential rises on both. The sharp rod breaks down into corona under a relatively low

potential. The blunt rod holds its charge, with ions accumulating on the blunt end.

As the ground potential builds, the corona builds around the sharp rod, while the blunt rod holds its charge. When the ground potential becomes quite high, such as when stepped leaders are on their way down from the cloud, the corona builds in density and elevation around the pointed rod. When the blunt rod finally breaks down, it breaks down catastrophically, and the accumulated charge jumps off the blunt rod in a streamer extending well up toward the stepped leaders.

Because the object on the ground that throws off the best streamer is the one most likely to be struck by lightning, the blunt rod is more likely to trigger a strike than is a sharp rod. Static dissipation technology uses the point discharge principle to produce corona and to reduce arcing or streamer-forming.

#### Air terminal standards

Streamer-influencing technology has matured to the point where the National Fire Protection Association (NFPA) has formed a committee, NFPA 781, to write standards for the application of early

streamer-emitting air terminals. The change in streamer-initiation time ( $\Delta T$ ) describes the influence air terminals have on streamer formation.  $\Delta T$  is the change in time of the release of the streamer from a particular air terminal as compared to a conventional lightning rod.

$\Delta L$  is the change in length, or more importantly height, of the streamer, and is derived from  $\Delta T$ . The earlier a terminal emits a streamer, the longer the streamer, and the greater its head start compared to other streamers emitted nearby. Earlier, longer streamers have a better chance of reaching the stepped leaders first and completing the lightning strike to the air terminal. This positive  $\Delta T$  is the basis of early streamer-emitting technology.

Conversely, an air terminal that retards streamer formation or exhibits a negative  $\Delta T$  and  $\Delta L$  is less likely to complete the lightning strike to itself. Because an electrical charge accumulates on—and streamers tend to emit from—a structure according to the principles of point discharge in a predictable manner, a structure properly blanketed by such air terminals is protected because streamers tend not to emit from such a structure.

# WE'VE GOT THE POWER ⚡

We offer the most  
complete line of application  
specific and standard  
*fixed attenuators and terminations*  
in the industry.

**JFW...The Power Leader**

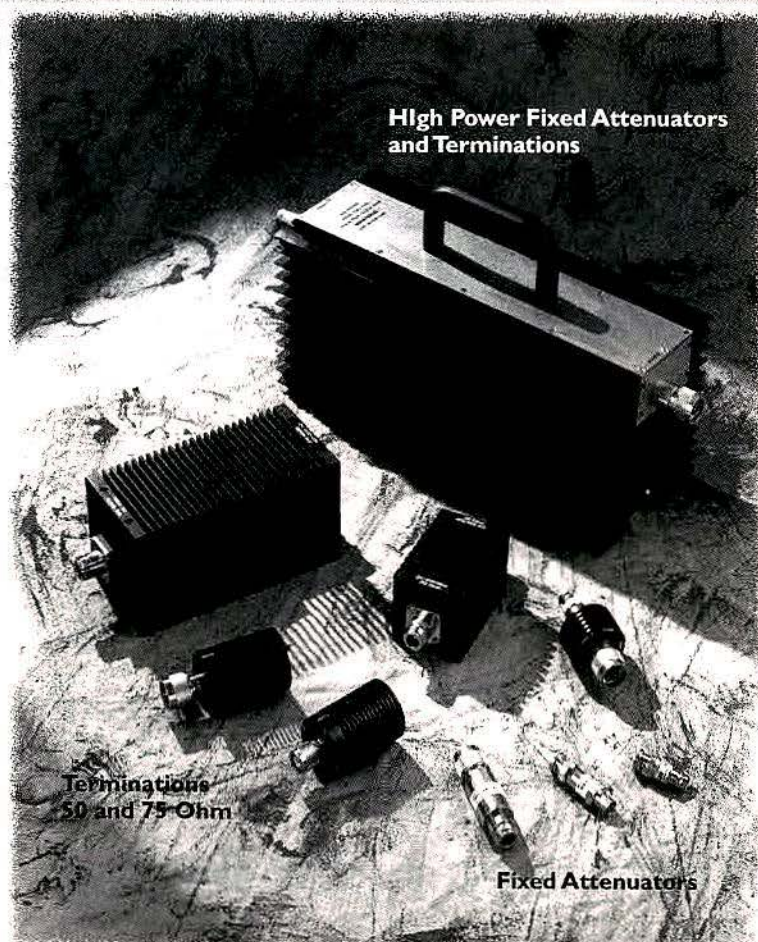
Circle (73) on Fast Fact Card

For more information or for a free catalog, contact:

**JFW Industries, Inc.**

5134 Commerce Square Drive  
Indianapolis, Indiana 46237

Tele. (317) 887-1340 Fax (317) 881-6790





# COMMS IN PUBLIC SAFETY

*The only dedicated communications  
forum for the emergency services*

*Influence the future of  
communications for the  
public safety sector*

*Manufacturers and  
suppliers meet  
purchasers and  
specifiers of  
communications  
equipment and  
services*

**EXHIBITION &  
CONFERENCE**

**13-14 JUNE 1995**

**SANDOWN  
EXHIBITION  
CENTRE**

**ESHER  
SURREY**

Comms in Public Safety provides  
a dedicated forum for the purchasers,  
specifiers and suppliers of communications  
equipment and services.

Now in its fifth year, it is recognised as  
the only annual forum specifically for the  
emergency services and for all those involved  
in the public safety industry.

**AMBULANCE SERVICES**

**FIRE SERVICES**

**POLICE SERVICES**

**UTILITIES**

**PUBLIC TRANSPORT**

**EVENT MANAGEMENT**

**LOCAL GOVERNMENT**

**SECURITY**

☐ Please send me a  
programme/  
registration form for  
the conference when  
available

☐ I am interested in  
exhibition space.  
Please forward a  
floor plan brochure

☐ I am interested in  
visiting the exhibition

Name \_\_\_\_\_  
Job Title/Rank \_\_\_\_\_  
Organisation \_\_\_\_\_  
Address \_\_\_\_\_

Country \_\_\_\_\_ Post/Zip code \_\_\_\_\_  
Telephone \_\_\_\_\_ Fax \_\_\_\_\_  
E-mail \_\_\_\_\_

What is the primary business activity of your organisation?

Number of employees at place of work

I am unable to attend but would like  
to remain on your mailing list YES ☐ NO ☐

Please complete in BLOCK CAPITALS and return to:  
Beverley Lucas, COMMS IN PUBLIC SAFETY,  
Nexus Information Technology, Warwick House, Swanley,  
Kent BR8 8HY. Tel: 01322-660070 Fax: 01322-661257

The information given above may be stored and used for marketing purposes

Circle (74) on Fast Fact Card CIPS 10



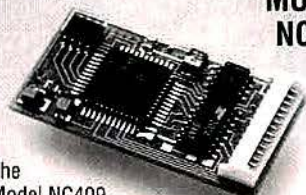
# D.T.M.F. SIGNALLING

For interconnect  
and remote control  
applications



**MODEL  
NC401**

The Model NC401 is a micro-miniature DTMF decoder, designed for selective control of local or remote applications. Measuring .80"W x 1.37"L x .23"H, the NC401 combines three distinct, multi-addressable decoders offering multiple user-configurable functions. All programmed features are stored in non-volatile E2PROM memory and are easily programmed by means of a conventional DTMF encoder or the Model NC500 Universal/P.C. programmer. This highly engineered decoder is ideal for portable radio applications having limited space for accessories. The NC401 comes complete with micro-miniature 14 pin header and 12" color coded cable assembly. For FREE detailed information ask for the NC401 user's manual.



**MODEL  
NC409**

The Model NC409 is a DTMF ANI/Alarm status encoder and companion product to the Model NC401 DTMF Decoder designed to automatically or manually generate any of the 16 DTMF characters. The NC409 features 15 memory locations of up to 30 digits each plus last number redial and multiple user-configurable functions. Programming is easily performed by means of a 12 or 16 button "X-Y" keypad with common ground or the Model NC500 Universal/P.C. programmer. The NC409 measures .85"W x 1.36"L x .165"H and comes complete with micro-miniature 14 pin header and 12" color coded cable assembly. For FREE detailed information ask for the NC409 user's manual.

**For detailed information  
or product catalog  
call 1-800-874-8663  
or Fax 916-477-8403**



12438 Loma Rica Dr., Grass Valley, CA 95945

Once the static dissipation family of products is recognized as a form of streamer-influencing air terminal, it becomes apparent that their successful operation is a function of the air-terminal portion of the system. Subsystems such as grounding and bonding, as long as they are included, become less significant in explaining successful product performance.

## Product advances

A correct understanding of operational theory has resulted in advances in product design, application and approvals. Indeed, when the theory was correctly understood, some manufacturers won Underwriters Laboratories listings for their products by presenting them as simple air terminals. Their streamer-influencing properties simply defined where they fell in the spectrum of air terminals, a spectrum that ranges from early streamer-emitting to streamer-delaying.

Understanding the technology also opened the door to other possibilities, including hybrid systems. Several years ago, the project management at the National Aeronautics and Space Administration's Cape Canaveral, FL, facility asked for a lightning protection system for its Advanced Launch System (ALS). Several design constraints made the use of a conventional system or a static-dissipating system impractical.

One option was a perimeter of early streamer-emitting air terminals surrounding the complex to lower the overall ground charge on the site. These terminals were to be complemented by a matrix of static-dissipating air terminals inside the site to retard streamers in the protected area. Working in conjunction, the two systems would have offered the possibility of a practical and effective solution, without compromising the ALS system design limitations. This approach highlights the idea that one type of system is not necessarily better than another. Each has its applications, and some applications are best served by a combination, or hybrid, approach.

## Scientific testing

Opponents of static dissipation technology sometimes call for scientific testing and proof that the technology works. Proponents of conventional lightning protection technology cannot call too loudly, though, because conventional lightning rod technology has never been subjected to the same level of scientific testing that some of them demand of static dissipation technology.

The limited tests of static dissipation products performed by the industry, by

users and by others have concentrated on the charge current-dissipating properties of the product under test. Acknowledging the streamer-influencing nature of the technology would call for measuring the products' ability to retard streamer formation. A direct lightning strike to the product under test would indicate the maximum possible discharge current flow, so it does not make sense to claim that "the higher the discharge current, the better the product."

Recent, incomplete studies show that different types of air terminals display dramatically different behavior in the short interval during which streamers form. It is hoped that continued testing will allow results to be quantified and compared among the various technologies and will lead to developing specific concepts to optimize air terminal design and installation configurations.

A step that could reduce confusion would be to cease referring to the technology as static-dissipation technology and to begin describing it as streamer-delaying. A clearer understanding of the operational theories and a clearer name for the products might lead the technology's opponents to take another look and to devote some of their energy to figuring out how and why it works.

## References

1. Block, Roger R., "Dissipation Arrays: Do They Work?" *Mobile Radio Technology*, April 1988.
2. Carpenter, Roy B. Jr., "Lightning Protection Devices: How Do They Compare?" *Mobile Radio Technology*, October 1988.
3. Bishop, Don, "Lightning Sparks Debate: Prevention or Protection?" *Mobile Radio Technology*, January 1989.
4. Bishop, Don, "FAA Tests Lightning Protection Equipment," *Mobile Radio Technology*, May 1989.
5. U.S. Patent No. 4,180,698, Dec. 25, 1979, Roy B. Carpenter Jr.

(*Mobile Radio Technology* back issues printed more than two years ago and article photocopies are not available from the publisher. For article photocopies, call or write University Microfilm International, Article Clearinghouse, P.O. Box 1346, Ann Arbor, MI 48106-1346, tel. 800-521-0600.)





## Technically speaking

(continued from page 8)

major divisions represent 5dB increments. For the +30dBm third-order intercept point, no adjustment is necessary.

### Using the graph

A few examples illustrate how to use the graph. Looking back at Figure 2, let's use the graph to determine the levels of the  $2B - A$  and the  $2A - B$  IM signals. In the case of  $2B - A$ ,  $B$  (+10dBm) is the *second-order* term, so locate  $B$  on the lower horizontal scale. Now move up as shown by the red dashed line to intersect the graph at point 1. Now, to take into account the *first-order* term,  $A$  at -10dBm, move down (down for negative, up for positive) 10dB to point 2 and back over to intersect the graph at point 3. From point 3 move up to the horizontal scale to find the level of the  $2B - A$  IM signal is -50dBm.

The level of the  $2A - B$  IM signal is found similarly. This is shown by the blue dashed line on the graph. This time, the *second-order* term is  $A$ , and the *first-order* term is  $B$ . The *second-order*  $A$  term (-10dBm) is located on the bottom horizontal scale. From here, move up to intersect the graph at point 1. Now, to take into

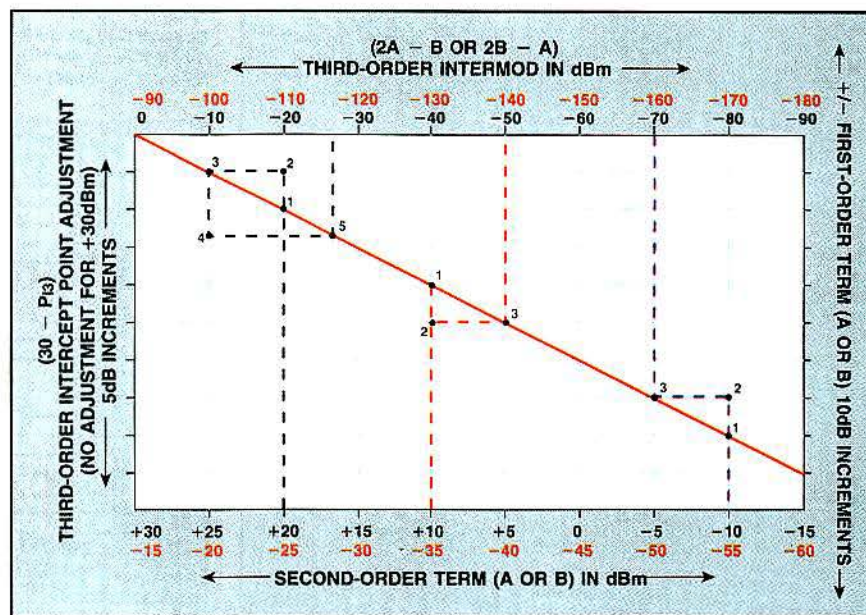


Figure 3. This graph can be used to determine the amplitude of third-order, two-signal IM signals such as  $2A - B$  or  $2B - A$ . See text for instructions on using the graph.

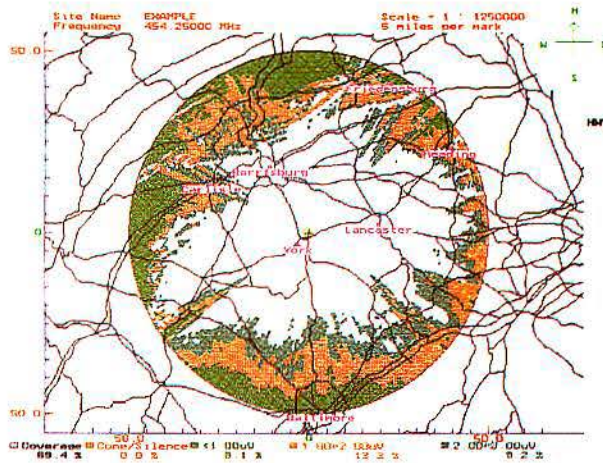
account the *first-order*  $B$  term (+10dBm), move up 10dB to point 2 on the graph. Now move back over to intersect the graph at point 3 and up to the top horizontal scale

at -70dBm. Thus, -70dBm is the level of the third-order ( $2A - B$ ) IM signal.

Here is an example using an amplifier with a third-order intercept point of



## RADIO ENGINEERING PRODUCTS



"Everything you need for Site Development and FCC Applications"

### SOFTWARE

3-D Terrain Viewer  
Coverage Predictions  
Fresnel Zone Studies  
Engineering Package  
Intermodulation Studies  
3- or 30-Second Terrain Files  
40/22 DHAAT Short Spacing  
Dispatching & Scheduling

### ENGINEERING SERVICES

Consulting  
Coverage Propagations  
2-10 Mile HAAT  
Frequency Selection  
Topographical Profiles  
Intermod Study  
40/22 DHAAT

### FCC INFORMATION

Direct Dial Access  
State Frequency Lists  
Custom Searches  
Mailing Labels  
Printouts  
Data Files

### C.E.T., INC.

1001 S. RIDGEWOOD AVE.  
EDGEWATER, FL 32132  
(800) 445-0297  
PHONE (904) 426-0014  
FAX (904) 426-0099

ASK FOR A FREE DEMO DISK



## Technically speaking

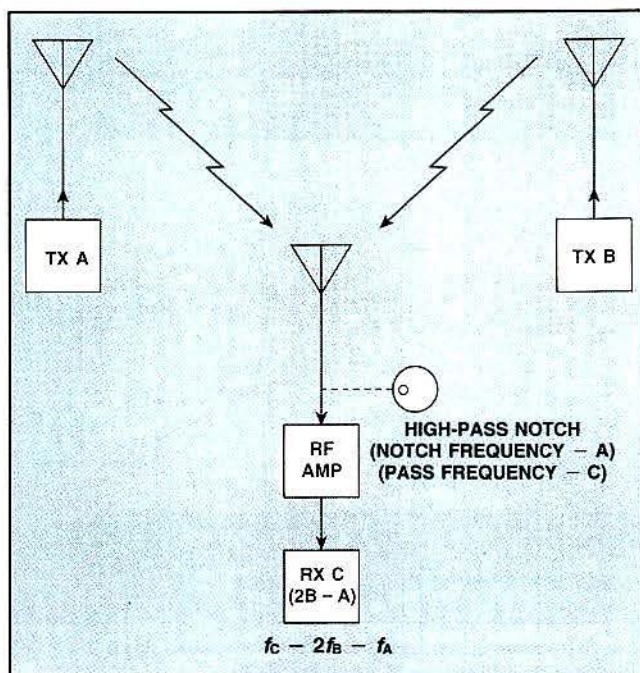


Figure 4. (to the left) Signals from transmitters A and B are mixing in receiver C to produce an IM "hit" on receiver C. ( $C = 2B - A$ ). A high-pass notch filter shown in dashed line can be connected to the line at the receiver to suppress the IM signal to a non-interfering level.

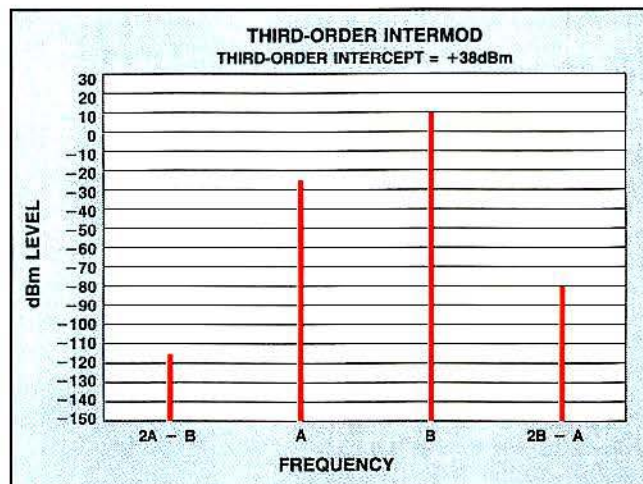


Figure 5. These signals are present at the output of the RF amplifier of Figure 4. Note that the level of the  $2B - A$  IM signal is at an amplitude of  $-80\text{dBm}$ . This would override the desired signal at a level of  $-106\text{dBm}$ .

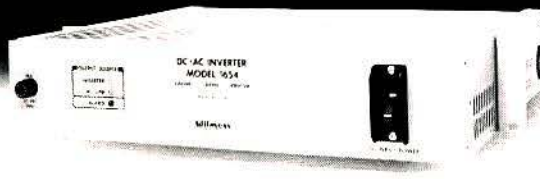
$+38\text{dBm}$  (a high-quality amplifier). The signal levels at the output of the amplifier are as follows: signal A is  $-25\text{dBm}$ , and signal B is  $+10\text{dBm}$ . What is the level of

the  $2A - B$  IM signal? First, locate  $-25\text{dBm}$  on the lower horizontal scale, and from there move up to the graph at point 1. Now, to account for the  $+10\text{dBm}$  level of signal

B, move upward  $10\text{dB}$  to point 2. Now move back to the graph line at point 3. Because the third-order intercept point of this amplifier is  $+38\text{dBm}$  instead of

## DC-TO-AC INVERTERS

1000 VOLT-AMPERES  
IN 3.5" VERTICAL  
RACK SPACE



MODEL 1654-48-120-60-U

- 120 VAC, SINGLE PHASE OUTPUT
- 24, 48 AND 130 VDC INPUTS
- 500 AND 1000 VA MODELS
- 19" OR 23" RACK MOUNTABLE
- OPTIONAL INTEGRAL TRANSFER SWITCH PERMITS OPERATION IN UPS/STANDBY MODES

**Wilmore** ELECTRONICS CO., INC.

PO Box 1329, Hillsborough, NC 27278 • Telephone: (919) 732-9351  
FAX: (919) 732-9359

## New: R-505 Field Strength Meter



A Handheld RF Signal  
Measuring System

Freq Range: 3 to 1000MHz

Accuracy:  $\pm 2\text{dB}$

PC Control via RS-232

Data Logging & Storage

Battery & Line Operation

Calibrated Antenna Systems are  
also available

**Z-Technology, Inc.**

P.O. Box 6806

Beaverton, OR 97007, USA

503/591-5051 • FAX: 503/591-0241



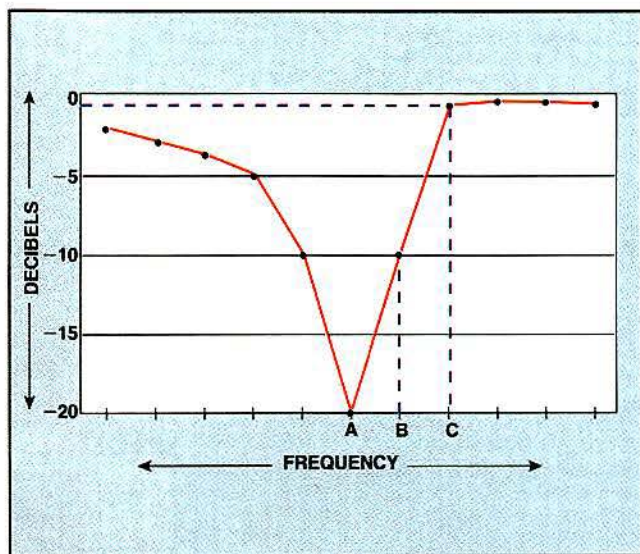


Figure 6. The frequency response of the cavity filter used in Figure 4 is shown here. Note that the signal from transmitter A is reduced by 20dB at the input to the receiver amplifier, whereas the signal from transmitter B is reduced by 10dB. The insertion loss at receiver frequency C is less than 1dB.

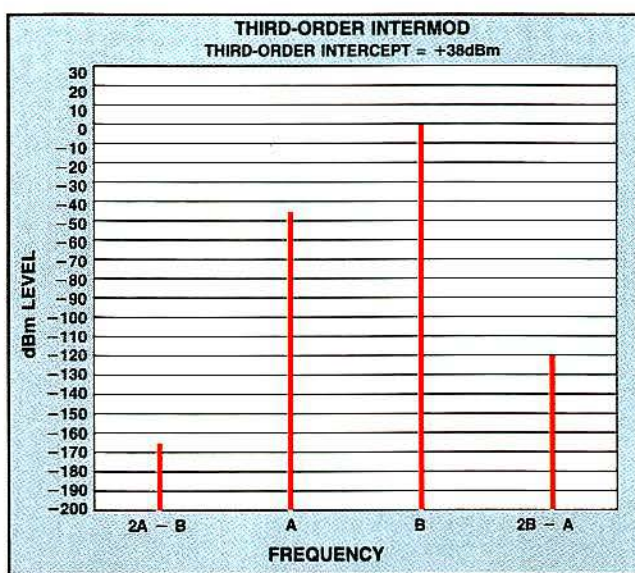


Figure 7. This is the level of the various signals at the Figure-4 RF amplifier's output after the high-pass notch filter is connected. Note that the 2B - A IM signal is now reduced to -120dBm, resulting in little or no interference to the desired signal.

+30dBm, we must adjust for the difference. The adjustment will be  $30 - 38 = -8\text{dB}$ . So, from point 3 on the graph, move down 8dB according to the left

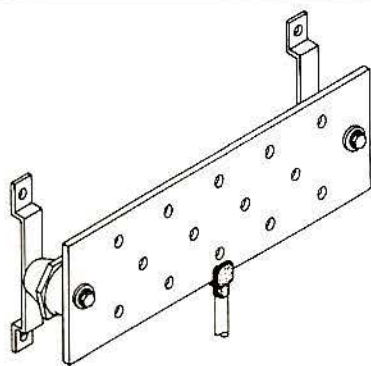
vertical scale to point 4. Next, move over to the graph line to point 5. From here, move vertically to the top horizontal scale to a reading of -116dBm. This is

the level of the 2A - B IM signal.

#### Receiver IM suppression

Figure 4 on page 80 shows signals from

## GROUNDING SPECIALISTS



- CUSTOM GROUND BARS
- CALL FOR A FREE CATALOG



**HARGER**<sup>TM</sup>  
LIGHTNING PROTECTION, INC.

LIGHTNING PROTECTION • GROUNDING  
SURGE SUPPRESSION

1066 CAMPUS DRIVE, MUNDELEIN, IL 60060  
(708)362-4848 • (800)842-7437 • (708)362-3519

Circle (79) on Fast Fact Card

**It's  
better  
to  
be  
safe,  
than sorry.**



Use Omnicron Voice Logging Recorders to document your important telephone and two-way radio conversations. They provide immediate review, plus a tape to store for future reference - the sensible way - at a sane price - from \$340.00.

Easy installation • Automatic voice activation • 2, 8, or 16 hours of solid talk time on each standard audio cassette • Fail safe alarms monitor tape movement to prevent errors • Optional Talking Time Clock repeats the time and date on a dedicated time channel. Omnicron has a full line of accessories: transcribers, tapes, sequencers, phone couplers, radio cables, etc. • Immediate delivery  
• 20 years of quality voice recording products and service •



**OMNICRON  
ELECTRONICS**

581 LIBERTY HIGHWAY  
P.O. BOX 623  
PUTNAM, CT 06260-0623

Phone: (203) 928-0377 — FAX: (203) 928-6477

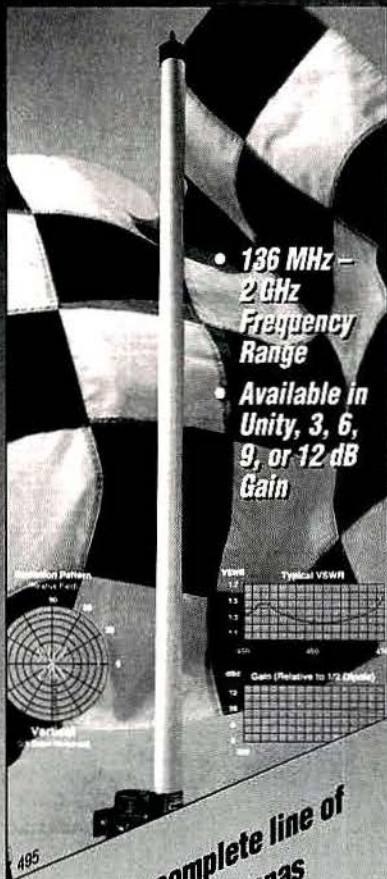
Circle (80) on Fast Fact Card



**HUSTLER**

## Catch the Winning Spirit!

If you want the best the world has to offer, catch the "Spirit" and win today.



- 136 MHz – 2 GHz Frequency Range
- Available in Unity, 3, 6, 9, or 12 dB Gain

**We have a complete line of**

- Base Station Antennas
- Mobile Antennas
- Duplexers/Combiners
- Coaxial Cables & Connectors

**SFD**  
SANTA FE DISTRIBUTING, INC.  
9640 Legler Rd., Lenexa, KS 66219  
Phone: 913-492-8288  
Toll Free: 1-800-255-6595

**FAX: 800-255-6596**  
For Fast, Easy Ordering!

## Technically speaking

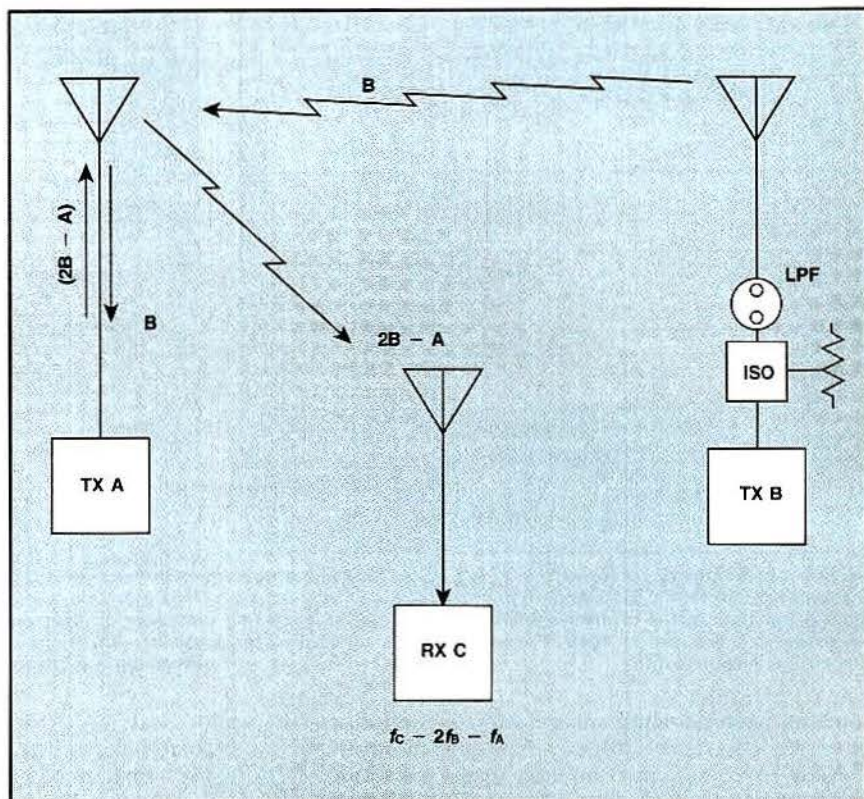


Figure 8. In this situation, the IM signal is being produced in the class C RF power amplifier of transmitter A. The IM signal can be suppressed by installing a proper isolator on the transmission line at transmitter A.

transmitter A and B mixing in the front end of receiver C. The frequency combination of  $2B - A$  happens to be right on the receiver frequency C. The levels of the various signals as they appear at the output of the RF amplifier of receiver C are shown in Figure 5. Suppose that it is desired that the receiver be able to receive a  $0.35\mu\text{V}$  signal on frequency C,  $(2B - A)$  with minimum degradation caused by the IM signal. Suppose further that the RF amplifier's gain is 10dB.

This means that, with a  $0.35\mu\text{V}$  ( $-116\text{dBm}$ ) signal at the input of the receiver RF amplifier, the output of the desired signal from the amplifier will be  $-106\text{dBm}$ . Note that the level of the  $2B - A$  IM signal at the RF amplifier output is  $-80\text{dBm}$ . This is 26dB above the level of the desired signal. A high-pass notch filter is placed on the line at the receiver RF amplifier input to suppress the IM signal to a non-interfering level. (See dashed line in Figure 4.)

The frequency response of the high-pass notch filter is shown in Figure 6 on page 81. Note that the level of signal A is attenuated by 20dB, and the level of signal B is attenuated by 10dB. So what happens to the level of the IM signal at the output of the RF amplifier?

Figure 7 on page 81 shows the levels of

the various signals at the RF amplifier output after a high-pass notch filter is installed on the line before the receiver input. Note that the level of the interfering IM signal is now  $-120\text{dBm}$ . Remember, the level of the desired signal was  $-106\text{dBm}$ . So, even with the slight insertion loss of the filter at the desired frequency, the IM signal is now suppressed approximately 13dB below the desired signal and should not cause any significant degradation of the desired signal.

### Transmitter IM suppression

Figure 8 above shows a situation in which transmitter-produced intermodulation is producing an IM hit on an on-site receiver.

Note that an isolator and low-pass filter are inserted in the line between transmitter B and the antenna. The isolator provides a high degree of suppression for any signal traveling from the antenna back toward the transmitter. The signal traveling in this direction is "dumped" into the load resistor and dissipated as heat. The low-pass filter serves to suppress the harmonics that might be generated by the isolator.

Note that transmitter A has no isolator in the line. The signal from transmitter B at the antenna can come down into the transmitter's class C power amplifier and



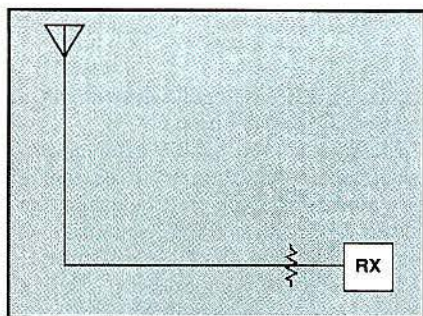


Figure 9. A simple attenuator pad can be inserted in the line at a receiver to determine whether the IM signal is receiver produced or radiated from another source. See text for details.

mix with the signal of transmitter A to produce an IM signal that will interfere with receiver C. To suppress the IM signal to a non-interfering level, an isolator should be installed in the line of transmitter A along with a low-pass filter to suppress any harmonics generated by the isolator.

#### Receiver-produced IM

Before setting out to suppress IM interference, you must first know where it is being produced. Is it being produced in the front end of the receiver, or is it being produced externally and radiated to the receiver antenna from another source? One simple way to decide is to use an attenuator pad connected before the receiver input. (See Figure 9 above.) If the IM signal is third-order and is being produced inside the receiver, the attenuation of the IM signal will be three times the pad attenuation value.

For example, if a 3dB pad is inserted into the line, the receiver-produced third-order, two-signal IM will be reduced by 9dB. Unfortunately, the desired signal will be attenuated by 3dB, but we gain the advantage of a 6dB difference with the IM signal. A fifth-order, two-signal IM product will be reduced by 15dB. If the IM signal drops less than the expected amount but more than the pad attenuation, the IM signal is probably a combination of receiver-produced and radiated IM.

There is much more to be written about intermod than can be included in this space. This column has only scratched the surface; however, there is a book dedicated to the subject of intermodulation control. The book, *Intermod Control*, was written by William F. Lieske Sr., president of EMR, Phoenix, AZ. Lieske is a recognized authority on the subject of intermodulation control. The book is available from Wiesner Publishing. Individual copies can be ordered for \$10 postpaid with a check or money order made out to Wiesner Publishing, Attention Mike Peterman, 7009 S. Potomac, Englewood, CO 80112;

tel. 303-397-7600; fax 303-397-7619.

A large, functional version of the graph in figure 3 is available from the author for \$2.00 post-paid.

A computer program that is useful in calculating IM hits and third-order, two-signal IM is available from the author for \$12.50 plus \$2.50 for shipping and handling. These programs run from MS-DOS on a PC and are available on a 3.5" or 5.25" floppy diskette. You may write the

author at 204 Tanglewylde Drive, Spartanburg, SC 29301-2949.

Stay tuned!

#### References

1. Christiansen, Donald, and Donald G. Fink, *Electronics Engineer's Handbook*, 3rd edition, 1989, McGraw-Hill, New York
2. Lieske, William F. Sr., *Intermod Control*, 1984, Wiesner Book Company, Littleton, CO.



## AE-1 .... ANI / ENI\* High Speed DTMF Encoder

The AE-1 is a High Capacity MICRO MINIATURE ANI / ENI DTMF ENCODER designed into a micro computer to generate the most precise, clean and transit-free DTMF signal ... ever!

The OPTIONS and POSSIBILITIES of the AE-1 are ENDLESS!

Being familiar with the PIPO ANI VER 4.0 features, any DTMF string configuration of pauses, waits, delays, speed adj., xmtr ptt, memory connect and more are possible. Superb engineering and surface mount components allow this unit to fit into the smallest radio, hand held or even a microphone.

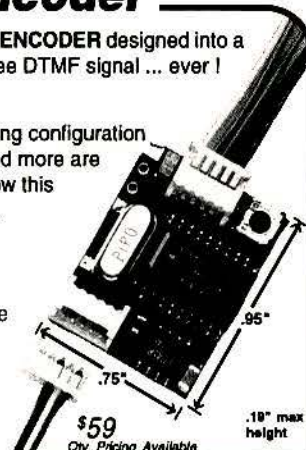
#### FEATURES

- Non-Volatile Memory
- Micro Miniature Jack / Plug
- 5, 10, 20 DPS Or Custom Time Base
- ANI / ENI 90 Digits Each
- 9-26 VDC @ .5 ma
- Mic Mute / PTT Output
- 1 kHz Tone Feature
- CW ID Option

#### EASY PROGRAMMING

- Free Factory Programming
- Field Programmable
- PC Programmable W / Pipo Software
- Programmable From Pipo DTMF Encoder / AE-1 Programmer
- Re-Programmable Anytime

\* ANI ... Automatic Number Identification  
\* ENI ... Emergency Number Identification



**Pipo Communications**

Emphasis is on Quality & Reliability

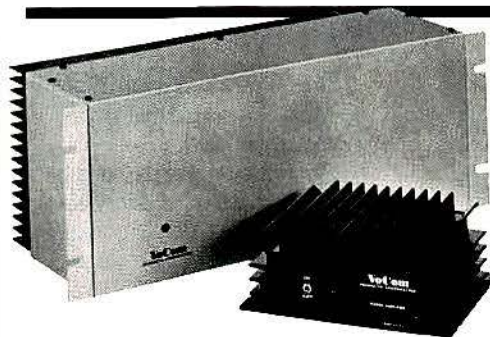
P.O. Box 2020 • Pollock Pines, California 95726-2020

CALL 916-644-5444

or FAX 916-644-7476

Circle (82) on Fast Fact Card

## BIG or SMALL We Have It All!



**VoCom / RF Corporation**

Quality since 1979

1-800-USA-MADE

(1-800-872-6233)

FAX 708/924-9078

### POWER AMPLIFIERS FOR ALL INPUT LEVELS

- VHF Low Band to 300 watts
- VHF High Band (140-200 MHz) to 500 watts
- UHF Low Band (400-550MHz) to 350 watts
- UHF High Band (800-960MHz) to 140 watts
- True continuous rating at high ambient temperatures
- FCC type accepted

Circle (83) on Fast Fact Card

Visit us at IWCE, Booth #2108.



## Conducting AVM in the DMZ

By Robert H. Schwaninger Jr.

The FCC has released its decision in PR Docket No. 93-61 regarding the future use of the 902MHz-928MHz band. In the words of Commissioner James Quello, this decision is the "first step into a potential bog of interference problems." Quello's characterization is terribly pessimistic about the quality of this decision and how it will play out in time, particularly if you consider that he voted for it!

Having followed this rulemaking proceeding since its inception, I must agree with Commissioner Quello. In fact, the only difference that he and I have is that I would not have voted for it. However, to be fair to the Good Commissioner, he is probably sick of meeting with all of the manufacturers of automatic vehicle monitoring (AVM) devices, Part 15 devices, electronic traffic and toll management (ETTM) devices, cordless phones and spread-spectrum devices that have been queuing up for months to make but one more *ex parte* (one-sided) presentation to the commission staff.

The problems that the commission confronted in this docket are as follows:

- Some operators wanted exclusive al-

location of the frequencies for operation of devices to monitor the movement of objects in the marketplace through the use of multiple-transceiver systems operating at high power levels.

- Some of the operators wanted exclusive use of the frequencies for operation of ETTM equipment operating at lower power.

tection of unlicensed radio devices, which operate all over the band.

Meanwhile, the band's primary protected operators continue to be federal government operators and industrial, scientific and medical (ISM) equipment operators under Part 18 of the FCC rules.

In the spirit of King Solomon, the FCC decided to split the baby. It allocated some

of the spectrum for high-powered lousy mobile systems (LMS), but these users must protect the operation of certain classes of unlicensed radio devices. The agency allocated some of the spectrum for ETTM devices and similar radio systems that communicate with vehicles, but these operations do not have to protect unlicensed Part 15 devices. The amateurs can operate on the band, but on a secondary basis. Meanwhile, the federal government and ISM users still get primacy on the band as compared to all other users.

On first blush, this decision almost looks logical. After all, everybody got something, including the right to continue to operate on the band. But if you use a little logic, the true nature of the decision is to make an already hostile radio environment even more hostile.

Consider the practical position of a cordless phone manufacturer. He can



"HERE - WE'VE MADE OUR DECISION.  
- GOOD LUCK."

- Some of the commenters wanted protection of amateur radio operations.

- Other affected persons wanted pro-

Schwaninger, *MRT's* regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.

## SOLUTIONS

### New Revenue Sources

- Remote Monitoring □ Remote Control □ Telemetry □ Voice & Page Alarming

#### ULTRAc System

- Industrial site monitoring & control
- PC based or status panel central
- RTU's with up to 44 I/O points
- Expandable to 1000+ locations
- Easy to use PC software

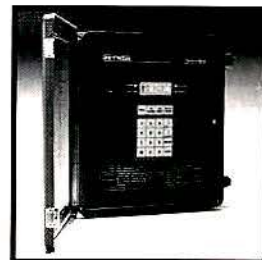
#### Control Link

- Point-to-point or multi-point
- Replace costly leased lines
- Integrated control/status panel
- 40 inputs & outputs
- Use any two-way radio or wireline

#### SentriVoice & SentriDial

- Monitor alarms & alert over radio or phone
- Autodialer - up to 120 numbers
- NEMA case with battery backup
- Respond via remote control
- 2 minutes of voice storage
- Integrate with SCADA/Telemetry
- Automatically send pages

Cost-effective solutions by a  
leading supplier of Radio  
Communications Systems.



**ZETRON®**

Zetron, Inc., Industrial Systems Division, 12335 134th Ct. N.E., Redmond WA 98052, Ph: (206) 820-6363 Fax: (206) 820-7031

Circle (84) on Fast Fact Card



produce phones to operate on the LMS spectrum where the FCC said that LMS devices will be afforded some protection. But, will the typical consumer of his devices know the source of the harmful interference? No. Instead, the consumer will merely return the "defective" device to the retailer. Therefore, the protection granted is probably illusory at best because it is unlikely that anyone will ever demand it.

OK. Then, the same manufacturer can choose to operate the devices on the ETMM frequencies. However, operation on those frequencies is unprotected, and the band soon will be shared with other "non-multilateration" systems that will compete with the cordless phones for occupation of the spectrum. In such cases, the lowest-power device normally loses. Too bad for cordless phone manufacturers and operators and consumers.

The really screwy situation will be experienced by the ETMM system operators. Their systems are typically a hybrid, with the transceiver being a high-powered device and the associated tags being unlicensed Part 15 devices. This means that the transceiver is eligible for protection, but the tags are not. In addition, the commis-

sion has stated that there is no reason to impose coordination of the use of the frequencies for operation of ETMM systems as against other non-multilateration systems. Operators are just supposed to use good sense.

As one might expect, the FCC will auction the use of the spectrum for future LMS use, but not for ETMM use. However, the FCC will "grandfather" some of the presently licensed systems, even though operation of those systems probably does not comply with the new rules.

Taken as a whole, this decision is either the best of all possible worlds (given the political climate) or the worst of all possible worlds (considering the long-term ramifications). It is definitely a mixed bag, including grandfathering, auctions, primary use, secondary use, shared use, protection, rejection, allocation and hesitation. No spider ever weaved a more tangled web of rights and duties.

Perhaps the biggest problem that will arise from this docket is that many equipment manufacturers and system operators affected by it will claim victory. Each will find something in the docket for which they can claim a privilege, right or ability that did not previously exist. This rush to

claim victory already began within days of the release of the item, with some manufacturers of ETMM equipment going so far as to claim that the FCC had adopted permanent standards for all future Transportation Infrastructure Radio Service (TIRS) operations.

These claims are belied by many statements made by the FCC, particularly those included in the concurring and dissenting opinions filed separately by the commissioners. It is apparent that the industry has not seen the last of the FCC's review of this band. In fact, the FCC is presently considering a rulemaking proceeding regarding the possible exclusive allocation of some of the band for wind-shear detection devices.

These characterizations of victory sell equipment and sell stock. They do not relieve the interference problems that will most likely increase with time. In the words of Commissioner Quello, "Regulatory philosophies have come and gone over the years this proceeding has been pending, but the commission's principal regulatory philosophy is to prevent interference. And that is precisely what we may not have done here."



**Now till 8:00 p.m. E.T.!**

**YOU'VE HEARD ABOUT IT  
FAMOUS SERVICE  
NOW EXPERIENCE IT!**

**ECC** **CARTWRIGHT**  
COMMUNICATIONS COMPANY  
7812 Red Sky Drive  
Cincinnati, OH 45249 USA

**800-543-8614**  
Outside U.S. 513-489-1755  
Fax 513-489-1449

Circle (85) on Fast Fact Card

**For your remote power needs**

**PHOTOCOMM, INC.**

PHOTOVOLTAIC, SALES, ENGINEERING,  
AND DESIGN TO SERVICE ALL YOUR  
REMOTE ELECTRICAL ENERGY NEEDS.  
WORLDWIDE INSTALLATION.

**INDUSTRIAL DIVISION**  
9850-A WEST GIRTON DRIVE  
LAKEWOOD, CO 80227  
303-988-8208  
800-223-9580  
FAX (303) 988-9581

**KYOCERA**

Circle (86) on Fast Fact Card



# MOBILE COMMUNICATION INSTALLATION SYSTEMS



- Airbag compatible • Install and position MDT's & laptop computers • Install mobile radios & control heads • Cup holders
- Switch panels with fuse holders or circuit breakers • 12-volt accessory plugs • Armrests • Locking storage compartments and more

Call for complete information and catalog



"providing solutions to all your installation challenges"

P.O. Box 1607 • Tomball TX 77377 • 1-800-527-1079 • Fax: (713) 356-0099

Circle (87) on Fast Fact Card

## The "Dr." is In!

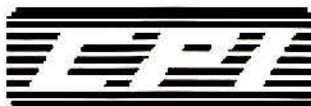


### The New "DR" Series DC Remotes

Whether you're delivering a new DC remote system or curing an ailing one, the new DR series remotes from CPI are the right prescription. The DR's sleek new styling and impressive features are just what the Doctor ordered.

#### Features include:

- Dip switch selection of control current format. No adj. pots or PCs needed.
- 2 watts of speaker audio.
- True Parallel PTT indication.
- Line continuity sensor.
- Can operate off of 12 VDC.
- Parallel cross mute.
- Optional Wall mount kit.



Call now to receive current pricing and specification sheets.

1186 Commerce Drive • Richardson, TX 75081  
(214) 437-5320 • FAX (214) 437-5360 • (800) 869-9128

Circle (88) on Fast Fact Card

## N<sup>ews</sup>

### Centurion signs \$100 million agreement with Ericsson

Centurion International, Lincoln, NE, has signed a four-year, \$100 million agreement with the cellular phone division of Ericsson, Research Triangle Park, NC.

According to the agreement, Centurion will provide \$100 million (revenues) in nickel cadmium and nickel-metal hydride batteries for Ericsson's digital and analog cellular phones.

### Antenna Farm changes name to AF CommSupply

The Overland Park, KS-based distribution company, Antenna Farm, has changed its name to AF CommSupply. In addition to the new name, AF CommSupply has expanded the number of product lines it stocks to include products from Celwave, Marlboro, NJ; Allgon Mobile, Grand Prairie, TX; The Antenna Company, Itasca, IL; and LoPro antennas from Northpoint Communications Products, Chicago. Warehouse space is being increased by more than 50% to accommodate the additional stock, and service hours have been expanded to 8 a.m.-6 p.m. CST Monday through Friday.

### ATG, GTE sign multimillion dollar purchase contract

Allen Telecom Group, Cleveland, has reached a three-year, non-exclusive open purchase agreement with GTE Communications Systems, Irving, TX. The multimillion dollar contract provides an open procurement avenue for all of GTE's domestic and international business units whenever the need for wireless communications equipment should arise.

The contract calls for ATG's Antenna Specialists, A/S Site products and Decibel Products divisions to provide mobile antennas, base station antennas and site management systems, respectively, to the various GTE business units.

### RAM Mobile Data reports large increase in subscribers for 1994

As of December 31, 1994, RAM Mobile Data, Woodbridge, NJ, reported a total of more than 27,000 subscribers, compared with a subscriber base of about 5,600 at the end of 1993. 1994 was the first full calendar year of RAM service since the nationwide deployment in July 1993.

More than 10,000 subscribers were added in the fourth quarter of 1994, an increase of 59% over the subscriber base of 17,000 at the end of the third quarter.





## Readers' choice

Of all the new products and services in the August 1994 issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

### Coax weatherproofing prevents buildup of moisture in cables

Cold Shrink, developed by **Andrew and 3M**, is a weatherproofing kit for a variety of sizes of Andrew's coaxial cable. Cold Shrink applies a continuous compression to prevent moisture from migrating into a coaxial cable system

through the connector interface. No heat gun, tape or installation tools are required. Installation takes less than three minutes, and the appliance can be easily removed for re-entry into the connection.

Circle (500) on Fast Fact Card

### Antenna analysts display full SWR curve over frequency range

The SWR-121 Antenna Analysts from **Advanced Electronic Applications** use an LCD to graphically display antenna SWR vs. frequency. Both a VHF/UHF model and an HF model are available. The analysts combine a microprocessor-controlled frequency synthesizer with a low-power SWR bridge. The keypad

allows selection of center frequency, frequency range and step size. The readout displays the antenna's SWR curve over an entire range, not just at one frequency. The analyst also can be used to measure return loss in decibels in a length of coax.

Circle (502) on Fast Fact Card

### Portable models provide features aimed at local, itinerant job sites

**Motorola** has added three models to its Spirit Pro two-way radio series. The 6.2-inch-high Spirit 2-Way operates on VHF local and itinerant job site frequencies. The 1W, one-channel radio has a two-mile operating radius, depending on terrain. Features include a squelch module and NiCd batteries, which can be recharged in the radio.

The 5.3-inch-high Spirit Pro has the same features as the 2-Way, with an additional audio accessory connector for a remote speaker mic, headset with swivel boom mic and an ear microphone. An optional vox adapter is available.

The Spirit Pro+ features one channel with 2W of transmit power and a two-mile range. The 5.3-inch-high radio operates on UHF job site frequencies for both FCC-designated local and itinerant use. The Pro+ model also has an audio accessory connector and is vox-capable.

Circle (501) on Fast Fact Card

## Save time designing, optimizing, and managing wireless RF communication sites!



Eliminate the "Shotgun" Approach to Site Design and Management:

- Intermodulation Interference Analysis
- Transmitter Noise and Receiver Desense Analysis
- Radiation Hazard Analysis
- Site Facilities Design
- Site Management Database

# COMSITE<sup>TM</sup> PLUS

BY DOUGLAS INTEGRATED SOFTWARE  
1350-E4 Mahan Drive, Suite 160, Tallahassee, FL 32308

For a detailed brochure, call 800-845-0408 or 904-656-8673.  
Individual communications site consultation available.

## TRANSMITTER LOCATION

### Direction Finding System Tracks Down

- Stuck Microphones
- Cable TV Leaks
- Jammed Repeaters & Cell Sites

Models available with computer interface, synthesized speech, for fixed or mobile use, covering 50 MHz to 1 GHz. Call or fax for details



Circle (90) on Fast Fact Card



## Spectrum A New Dimension In Repeaters

*Spectrum Repeaters & Base Stations provide a New Dimension in 'on the air' performance that lasts — year after year, even under the worst conditions. Thousands of our units have been operating all over the world for over 20 years...with excellent reports.*

Our friendly sales and technical team are very accommodating and happy to discuss the details of your system. Every customer is *important* to us — you're not just a number, as you often are with our competitors! Give us a call or FAX today regarding your Repeater, Base, or RF Link needs.

### FEATURES

- Deluxe Models with Full Panel Metering & Controls
- Low Cost Basic Units
- Super Sensitive & Selective Receivers
- RX Helical Resonator Option
- Excellent Quality Audio
- 100% Duty Cycle
- Provision for: Interconnect, DTMF Remote Control, Tone Panel, etc.
- Also Available: Duplexers, Cabinets, Antennas, etc.



**S-7R  
Low Cost  
Repeater**

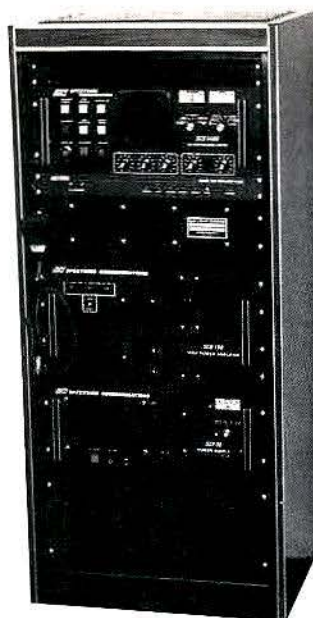
**VHF/UHF  
2-150 Watts**



**SPECTRUM COMMUNICATIONS CORP.**

1055 W. Germantown Pk., Norristown, PA 19403 • (610) 631-1710 (800) 220-1710 FAX: (610) 631-5017

Circle (91) on Fast Fact Card



**New SCR 1400  
150W Rptr./Base**

## New products

Noise-canceling microphone  
features rugged design specs



The 592T handheld electret condenser microphone from **Shure Brothers** features noise-canceling technology and uses Shure's Modulink cord and connector system. Designed for rugged and reliable operation in high-noise environments, the 592T has a bidirectional pickup pattern for clear transmission. The mic has low sensitivity to hum pickup and low susceptibility to RF interference. The casing is designed to be immune to environmental deterioration, shock and vibration.

Circle (471) on Fast Fact Card

## Diversity Reception Really Sucks...



## Data Out Of RF Noise!

**ElectroCom's** Diversity Reception Controller revolutionizes mobile data communications. The Diversity system eliminates data dropouts caused by Rayleigh fading, resulting

in increased reception in marginal areas. For more information or technical specs call **ElectroCom** at: 1 (310) 946-9493 or fax to: 1 (310) 946-7483

**ElectroCom Communication Systems**

10400 Pioneer Blvd, Bldg E-2 Santa Fe Springs, CA 90670-3728



Visit us at IWCE/Spring, Booth #4051

Circle (92) on Fast Fact Card

Portable provides compatibility  
with different trunking formats

**Standard Communications'** HX582T is a compact, rugged 2W radio fully compatible with either LTR or Privacy Plus trunking formats. It also operates as a conventional 10-channel, 800MHz radio supporting talkaround channels. The radio meets military specifications for hazardous environments. The radio's 10 systems and 109 groups can be tracked by programming its microcomputer for scanning. Nonvolatile memory stores all frequencies and operating parameters without a backup battery. A backlit, alphanumeric LCD shows scan status and other functions. Features include a time out timer and busy channel lockout.



Circle (472) on Fast Fact Card



## Dual-protocol mobile radio includes high-speed scanning



The GX5810T from **Standard Communications** is a compact mobile radio featuring dual-protocol technology (LTR and Privacy Plus-compatible), conventional 10-channel, 800MHz operation with talkaround and simple telephone interconnect. The 15W radio has high-speed scanning of as many as 10 systems, one group per system. Ten

channels also can be scanned in conventional 800MHz mode. Both CTCSS and DCS tones can be programmed with a PC. An optional backlit DTMF mic allows telephone interconnect. Other features include status indicators, password protection and a vehicle horn alert function for incoming calls.

Circle (473) on Fast Fact Card

## GPS tracking module supports external devices, status sensors

The second-generation V-Track GPS-based tracking module from **Radio Satellite Integrators** is designed for vehicle, vessel and object tracking. New features include a more rugged design to military specifications, improved power conditioning circuitry and higher temperature range capabilities for hostile mobile environments. Additional data and accessory ports support external devices such as MDTs, emergency buttons and vehicle status sensors. A 10-channel, all-in-view GPS receiver provides instantaneous satellite switching to eliminate losing the signal lock on a moving vehicle.

Circle (476) on Fast Fact Card

## Pager offers user, carrier features

The Quest LS pager features a top-view LCD, travel alarm, time stamp and six programmable alerts. The unit from **Uniden America** offers 30-message capability and individual or global message deletion. Carrier features include out-of-range indicators, enable/disable message error display, 1,200/2,400-baud capability, test mode and a five-digit security code.

Circle (474) on Fast Fact Card



## Molded stubby antenna replaces original retractable for Micro-Tac

A fixed replacement antenna is now available from **Centurion International** for the Motorola Micro-Tac (flip) phone. The fully molded replacement snaps into position after the hood surrounding the manufacturer's original retractable antenna and the antenna itself are removed. The replacement, model CXS-MFP, is a quarter-wave stubby version, in keeping with the compact design of the phone.

Circle (475) on Fast Fact Card



## Interference analysis software includes filter curve libraries

**Douglas Integrated Software's** ComSitePlus version 3.6 software helps identify and prevent wireless communications site interference. The PC-based software provides analysis of intermodulation signal levels, transmitter noise and receiver desensitization. Version 3.6 provides equipment and filter curve libraries for Ericsson and Motorola radio equipment, as well as Celwave, Decibel Products, Telewave and Wacom filter/curve libraries. The software works with all land mobile radio bands (500kHz to 3,000MHz) and can evaluate 1,000 frequency pairs per communications site data file.

Circle (477) on Fast Fact Card

## Digital processing makes link transparent to mobile user

**IDA** has added digital signal processing technology to its Net-Link LTR networking product. The Wordsaver feature builds on IDA's vox and digital voice delay technology for land mobile use. Wordsaver makes the Net-Link virtually transparent to the mobile radio user.

Circle (478) on Fast Fact Card

# CADEX Slashes Battery Costs by 50%

*"CADEX brought 50% of our supposedly dead batteries back to life."*

Clare Wren,  
Communications Manager,  
State of Oregon Dept of Forestry



**1 • 800 • 565 • 5228, Ext 123**

CADEX ELECTRONICS INC. 111 - 7400 MacPherson Ave., Burnaby, BC Canada V5J 5B6  
Tel 604/451-7900 Fax 604/451-7991

Circle (94) on Fast Fact Card

Visit us at IWCE/Spring, Booth #2081



# MicroTalk

World's Smallest Two-Way Radio

5 POWERFUL WATTS  
10 CHANNELS

**LIFETIME  
WARRANTY**

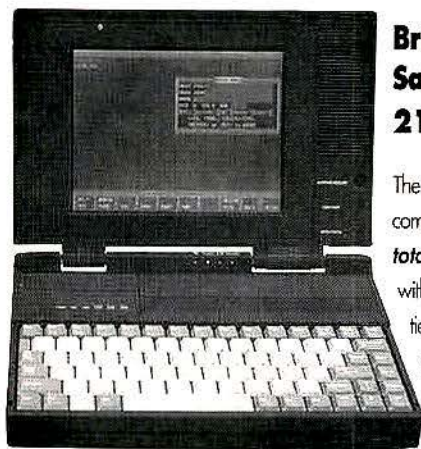
- 10 Synthesized Channels
- TX/RX Signal Strength
- Low Battery Alert
- Adjustable Power Levels
- Field Programmable
- Liquid Crystal Display
- Built-In CTCSS/Private Line
- 5 Free Accessories



Advanced Videotech Corporation  
1840 County Line Rd. • Huntingdon Valley, PA 19006  
800-233-0013 • 215-322-4600 • FAX: 215-322-2812

Circle (95) on Fast Fact Card

## The Newest Technology in Wireless Mobile Computing



**Bringing Public  
Safety Into The  
21st Century**

The METROPLEX wireless computer network features *total system integration* with expansion capabilities. It is the most complete state of the art equipment available.

**When you Need More Than Just the Facts!**

Call for more information:  
**1-800-DATAMAN**  
1-800-328-2626

**METROPLEX**  
MOBILE DATA, INC.



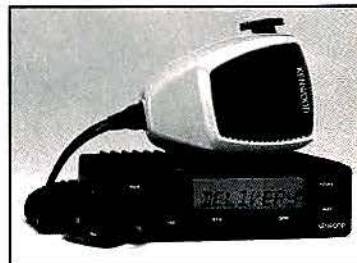
**Metroplex Mobile Data, Inc.**  
1640 West Oakland Park Blvd., Ft. Lauderdale, FL 33311

Circle (96) on Fast Fact Card

## New products

### Mobile packs trunking features into easy-mount unit

The TK-940/941 compact trunked mobiles from **Kenwood Communications** are designed small to accommodate any vehicle installation requirement. Features include dynamic systems and group capability (to 32 systems); eight-character alphanumeric display; flash memory; data-ready connection port; computer programming and alignment; and password-protected programming. The 15W mobiles have a built-in 4W speaker and conventional systems capability.



Circle (479) on Fast Fact Card

### Digital voice recorder provides channel versatility

Comverse/Magnasync has expanded its Ultra series of digital voice recorders with the DVL Ultra Tower (DVL 2400). The recorder provides users the versatility of from eight to 32 recording channels. It combines a PC-based supervisor station, complete data security and flexible data storage. The unit comes with a hard disk storage system providing as many as 330 channel hours of playback for recorded calls.

Circle (480) on Fast Fact Card

### Board converts Yaesu/Vertex into trunking mobile

Gencron Engineering has created an LTR trunking conversion board for the Yaesu/Vertex line of mobile radios. The Universal Trunking Board (UTB) is a direct replacement for the Vertex mobile's logic board. The plug-in module converts a 12-channel UHF mobile into a 99-channel conventional and LTR trunking UHF radio. Rotating the channel select knob enables the user to change from trunking to conventional channels. Features such as frequencies, codes, and timing are programmed into the UTB via dealer software.

Circle (481) on Fast Fact Card

### HVAC system controls equipment environment

Sun Manufacturing has added 1/4-ton air conditioners to its Compact Series package of wall-mounted equipment. The units, for environmental control of communications equipment installations, are available in 120V and 208V/230V single-phase versions with as much as 7.5kW of electric heat.

Circle (482) on Fast Fact Card

### Encryption boards for Motorola radios ensure security

Selectone has released two voice encryption boards for Motorola portable and mobile radios. The ST-25AMT is specifically designed for the Motorola MT-2100, MT-2000 and HT-1000 portables. The ST-25AMC is designed for the Motorola MC-900 and MC-2100 mobiles. Both models incorporate the ST-25A rolling encryption algorithm that provides 268 million code keys and high-level voice security for two-way systems. Input and output filters provide high-quality, low-distortion audio recovery.

Circle (483) on Fast Fact Card



## Catalog features solar electric power systems

A 32-page solar electric wireless power products catalog from **Photocomm** includes the company's line of solar electric power systems for cell sites, repeaters, fixed site phones and other wireless power applications.

Circle (490) on Fast Fact Card

## Data sheets outline network analyzer's performance

Two technical data sheets from **Anritsu Wiltron** outline the 37200A series vector network analyzer's system performance, measurement and display capabilities and measurement uncertainty curves. Special sections highlight the 37200's sweep speed, GPIB data collection speed and typical in-fixture performance across the analyzer's frequency range.

Circle (491) on Fast Fact Card

## Reference book describes linear circuit design

A 700-page linear circuit design reference book contains 11 chapters of how-to applications information. The book from **Analog Devices** is tailored to the entry-level design engineer, advanced college student and engineers who are not familiar with the fundamentals of linear circuits. The text provides circuit descriptions and is illustrated with schematics, performance curves and charts and equations to allow the designer to predict performance in the circuit.

Circle (492) on Fast Fact Card

## Catalog lists wireless publications

A 32-page catalog from **Communications Publishing** includes books, newsletters, software and videos for the wireless industry. It covers designing and operating wireless systems, training employees, marketing wireless services, installing and programming cellular phones, roaming with cellular phones, broadcasting data and investing in wireless.

Circle (493) on Fast Fact Card

## Data sheet introduces amplifiers

A product line data sheet from **Chesapeake Microwave** introduces a line of MMDS and IFTS power amplifiers. It defines all critical features and electrical specifications and includes outline drawings and measured performance graphs.

Circle (494) on Fast Fact Card

## Catalog covers electronic test accessories

A 172-page catalog contains more than 3,800 products arranged in an easy-to-read format, including selection guides. The catalog from **ITT Pomona** contains two short tutorials on "Selecting the Right Scope Probe" and "Extending Your DMM's Capability." Products include a series of 30MHz-450MHz oscilloscope probes, IC test clips, sealed polycarbonate and die-cast aluminum enclosures, a pocket-size logic scope probe and ultra-thin micrograbbers for testing fine pitch ICs.

Circle (495) on Fast Fact Card

## Pricebook includes radio accessories

A 272-page pricebook features more than 50 land mobile radio (LMR), specialized mobile radio (SMR), paging and site equipment product lines. Part numbers, product descriptions and pricing appear in a logical format that will make ordering easier. The pricebook from **Communications Associates** is organized in alphabetical order by manufacturer.

Circle (496) on Fast Fact Card



Introducing  
the BMAF Series  
of...

# MAXRAD

State of the Art Antennas  
State of the Art Antennas



Glass Mount  
Antennas

Setting the Pace

## The Benchmark of Quality

MAXRAD • 4350 Chandler Drive • Hanover Park, IL 60103 • USA  
Order: (800) 323-9122 • Fax: (708) 372-8077 • Phone: (708) 372-6800

Circle (98) on Fast Fact Card





## QUALITY YOU CAN DEPEND ON

### Wireless Radio Telephone System

*Transmits Voice, Fax & Data*

The only equipment built for

- portable
- mobile
- and
- fixed operation.



**Marketronics**  
CORPORATION

INTERNATIONAL: (305) 846-1011  
USA: (800) 845-1230 FAX: (305) 846-1672

Circle (99) on Fast Fact Card

## Communication Power Products That Cover The Spectrum



LOCAL

REMOTE



Mobile ... Fixed

Local ... Remote

Components ... Systems

Wall Mount ... Rack Mount

Stock ... Custom

Power Conversion ... Power Protection

Microwave ... Cellular ... Telecom



COMPONENTS

SYSTEMS



**W**hen you need power products for any communications application, look to NEWMAR. With over 100 different models of power supplies, DC converters and battery chargers, chances are we can meet your needs right from stock.

Special applications or custom configurations are not a problem. Our power products are available with a wide variety of standard factory modifications. We'll even work with you to design complete rack power systems custom-tailored to your site requirements.

Contact the factory to learn more about how NEWMAR products cover the full spectrum of communication power requirements

**NEWMAR**

ELECTRONIC POWER PRODUCTS  
COMMUNICATION • NAVIGATION

Newport Beach, CA 92663 • Phone: (800) 854-3906 • FAX: (714) 957-1621

Circle (100) on Fast Fact Card

## P eople

**John Karstrand**, product manager for Communications Associates, Joliet, IL, advances to sales manager.

**Federico Crespo** departs C.E.S., Winter Park, FL, as manager of international sales to join Sigtone, Winter Park, as international sales manager.

**Edward (Ted) Laves** leaves Motorola's Cellular Infrastructure Group, Arlington Heights, IL, as director of wireless local loop products to join Illinois Superconductor, Evanston, IL, as executive vice president.

**Bill M. Lovelace**, national sales manager for Anritsu Wiltron, Morgan Hill, CA, advances to president.

**Leonard G. Taylor** departs Motorola C & E, Schaumburg, IL, as an account executive to join Midland International, Kansas City, MO, as area sales manager based in Fort Worth, TX.

**Richard L. Biby**, president of Communications Engineering, Falls Church, VA, a consulting engineering company, and **Richard P. Biby**, president of Communications Data Services, a data processing company in the same city, become principals in an additional company, Biby Telecommunications, which assists personal communications service (PCS) companies to design and implement PCS systems.

**Dan Hawkins** leaves the State of Montana's Department of Administration as telecommunications analyst to join Biby Telecommunications as senior software development engineer.



## EVER WISH YOUR EQUIPMENT WOULD CALL YOU BEFORE IT FAILS?

*If It's Monitored By ProTek - It Will!*

**Any equipment** (including pumps, generators, transmitters, receivers, repeaters and system controllers) of all types can be monitored by **ProTek**. In addition, key site conditions such as **tower lights, AC power, intrusion alarms, smoke detectors** and others can be monitored. **ProTek's** built-in relay outputs can be used to automatically control equipment at the site.

**Unique programmability** allows the user to create a sophisticated closed loop control system capable of automatic alarming. **ProTek's** inputs accept contact closures and DC voltages. The user defines input limits, time delays, qualifiers and relay outputs to be controlled. Any active input can be programmed to place an alarm call.

**An integral modem and speech synthesizer** allow **ProTek** to alert you to inputs out of limits by calling a person, pager or computer (up to 8 phone numbers in any combination). You can call **ProTek** from any time telephone and it will tell you the actual value of any input (in volts, watts or high/low levels). Using the telephone, you can control all relay outputs and listen to audio inputs.

**Time-stamped event recording** (stored in non-volatile memory) helps pinpoint intermittent problems. Best of all, no special computer software is required to program the unit - any Video Display Terminal can be used since all user friendly screen software is resident in **ProTek**.

To find out more about the **ProTek** family of Monitor, Alert and Control Systems, give us a call at (919) 876-8294 or FAX (919) 876-5666.



**ProTek** is totally expandable - up to 128 inputs, **ProTek** can handle up to 8 outputs.

**PAGETEK**

The Monitoring and Control Experts  
2801 Spring Forest Road  
Raleigh, NC 27604

Circle (97) on Fast Fact Card



# L *etters from readers*

## An allegory:

This is an allegory regarding the Information Superhighway and the Two-Way Radio Dealer, or How to Explain to Politicians, Bankers and Laypersons What the Hell is Going On.

Back before "I-Way" construction began, two-way radio dealers operated much as automobile dealerships, with sales departments, service departments and a gas pump. The dealership sold the automobiles (radios), serviced the machinery and sold the gas (airtime) to make the machinery work. Instead of the superhighway, there were a number of smaller, less-used roadways.

The market for the automobile was a great deal smaller than it is now. Only certain entities required automobiles, but those that needed them used them to a great extent. The automobiles required a fair amount of service to keep them running, and highly skilled technicians and expensive test equipment were required. Even though the market was much smaller, most dealerships made a good living in this industry. Many did so even though they were not involved in selling automobiles or gasoline. They did well just keeping the automobiles operating.

All the autos used locally available regu-

lar gasoline. Each dealer had his own blend of regular gasoline, and although some autos could be adjusted to use the locally available blend, others could not. Each dealer billed the customer directly for gasoline usage, so the auto user could receive gasoline bills from several dealers each month if he did a lot of traveling.

Now, the business climate is such that most new vehicles use unleaded gasoline. Autos that use leaded gasoline are still available and a few are still sold, but almost everyone wants a vehicle that runs on unleaded gas because it is available almost everywhere. The blend that is available is compatible with almost all new autos. No matter where the driver travels, unleaded gas is probably available, and he receives one bill per month no matter how far he travels. The demand for vehicles has been phenomenal. Almost everybody wants one.

One would think that this new market would be great for the established dealership. On the contrary, every facet of the dealership business is experiencing a negative effect. The dealership can sell the new autos, but so can every other business. Mass merchandisers, drug stores, diet centers, pool halls, saloons and fast-food restaurants are all selling automobiles, even

if they don't understand how the auto works. So many outlets are selling vehicles because producers of unleaded gas are so anxious to get customers that they give each dealer a large commission for selling each auto. This commission, coupled with the fact that the price of autos is dropping daily, has resulted in profit margins on selling autos to erode to the point of non-existence. The service business has taken a downturn because the cars are much more reliable and, when they do break down, the customer usually just buys a new auto rather than having the old one fixed.

The final blow to the business is that the dealership cannot sell the unleaded gas. This is only available from two large suppliers in each market. Furthermore, a government bureaucracy has decreed that all new oil fields that are opened up for the production of gas (leaded and unleaded) will be auctioned off to the highest bidder. The small dealership stands little chance of successfully competing in the auctions.

Me? I just want to find an off-ramp that has a dirt road leading to a trout stream.

Jim Arner  
America West C&E  
Rock Springs, WY



## RadioMate® SwitchMateII™

- Hands-Free desk-top dispatch.
- Talk on the telephone, transmit on the radio using a single headset.
- SwitchMateII™ combines radio, headset and SwitchMate™ in one space-saving unit.

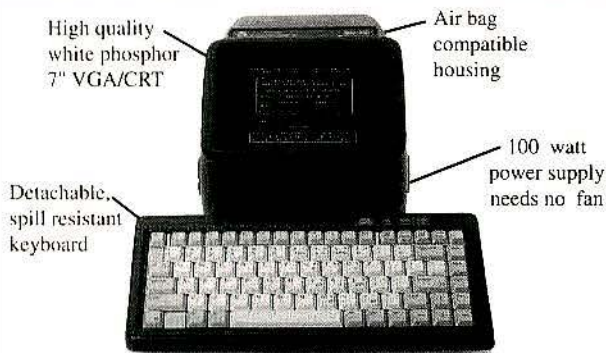
**RadioMate®**

"Professional Headsets for Professional People"

Call (800) 346-6442 Fax (510) 676-3387

Circle (101) on Fast Fact Card

## ElectroCom Announces The 1995 Model MDC-890 Mobile Data Computer



### Last Year's Options Are This Year's Standard Features:

- 486 SLC/33 MHz CPU
- 4 MB Dynamic RAM
- 1 MB Flash RAM
- 2 Expansion Slots
- Laminated, Glare Resistant Safety Glass

### The MDC-890 Is Compatible With:

- NCIC 2000 Standards
- Popular AVL/GPS Devices
- DataVision Head-up Display
- Magnetic Stripe Readers

**ElectroCom Communication Systems**

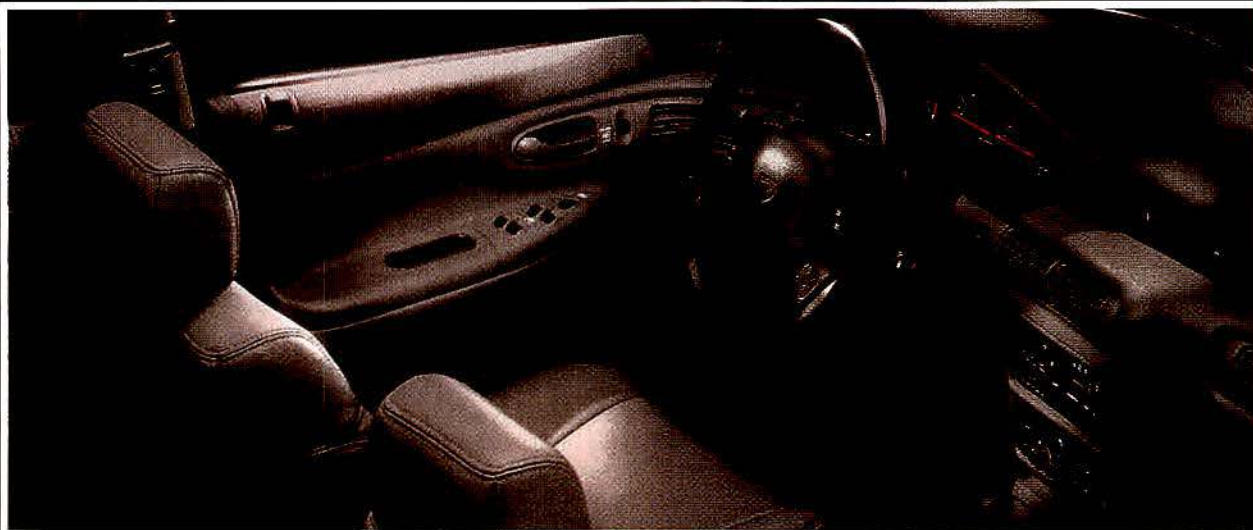
Tel (310) 946-9493 10400 Pioneer Blvd, Bldg E-2 Santa Fe Springs, CA 90670



Circle (102) on Fast Fact Card

Visit us at IWCE, Booth #4051.





DESIGNED BY PEOPLE WHO READ  
*ARCHITECTURAL DIGEST* AND *HOT ROD* MAGAZINE.

EAGLE VISION TSi. It's interesting how an Eagle Vision TSi can be so elegant and refined yet at the same time be so brutally powerful. You can experience this paradox firsthand when you take The Eagle Test Drive. Only then can you appreciate the style, technology, and performance of Vision TSi.

A quiet, spacious cab-forward interior, available leather-trimmed seating, and available 120-watt Infinity Spatial Imaging sound system give no hint to the power of the 214 horsepower 24-valve engine lurking under the hood. Not to mention an optional performance suspension that would make any sports car envious. For added safety, there are even dual air bags† and four-wheel anti-lock disc brakes.

So take The Eagle Test Drive. Then pick up your own copy of an Eagle Vision TSi.



THE EAGLE TEST DRIVE  
1-800-2-TEST-EAGLE





# Mobile Radio Technology™

The journal of mobile communications technology

## BUSINESS

Cameron Bishop, *Group Vice President*  
 Mercy Contreras, *Publisher*  
 Darren Sextro, *Associate Publisher*  
 Kathryn Buckley, *Promotions Manager*  
 Denise Kettler, *Senior Promotions Coordinator*  
 Liz Turner, *Senior Advertising Production Coordinator*  
 Nancy Hupp, *Advertising Production Manager*  
 Dee Unger, *Director Advertising Services*  
 Tammy Kalebough, *Classified Advertising Coordinator*  
 Tom Cook, *Group Senior Managing Editor*  
 Doug Coonrod, *Corporate Art Director*  
 Kim Bracken, *Art Director, Special Projects*  
 Stephanie Hanaway, *Group Director of Ancillary Products*

Raymond E. Maloney, *President and CEO*  
 Nick Cavnar, *Vice President of Circulation*  
 Barbara Kummer, *Circulation Director*  
 Michele Bartlett, *Circulation Manager*  
 Customer Service, 800-441-0294

## ADVERTISING SALES OFFICES:



## ENGLEWOOD, COLORADO

Carla M. Gamino, 303-220-4244, *East region (including Eastern Canada)*  
 Mercy Contreras, *Publisher*, 303-220-4245  
 5660 Greenwood Plaza Blvd., Suite 350  
 Englewood, CO 80111  
 Phone: 303-793-0448  
 Fax: 303-793-0454

## OVERLAND PARK, KANSAS

Joyce Bollegar, 913-967-1840, *Midwest region*,  
 Fax: 913-967-1901  
 Scott Thompson, *Classifieds*, 913-967-1923,  
 Fax: 913-967-1735  
 Chris Coughlin, *List Rental Services Representative*, 913-967-1928, Fax: 913-967-1897  
 9800 Metcalf Ave.  
 Overland Park, KS 66212-2215

## SAN RAFAEL, CALIFORNIA

Dennis Hegg, *West region (including Alaska, Hawaii and Western Canada)*  
 950 Northgate Drive, Suite 207  
 San Rafael, CA 94903  
 Phone: 415-491-1442  
 Fax: 415-491-1842

## OXFORD, ENGLAND

Richard Woolley, *International*  
 Jane Moseley, *International*  
 Unit 3, Castle Farm Business Centre, Clifton Road  
 Deddington, Oxford, OX15 4TP, United Kingdom  
 Phone: +44 (0)1869 338794  
 Fax: +44 (0)1869 338040

# P Professional services

PLANNING, DESIGN, DEVELOPMENT and REPAIR  
 ANTENNA SYSTEMS, VEHICLE LOCATION SYSTEMS,  
 DATA, VOICE and VIDEO COMMUNICATIONS SYSTEMS



Steven L. Myers, Ph.D., P.E.  
 President

MYERS ENGINEERING INTERNATIONAL, INC.

P.O. Box 15908, Fort Lauderdale, FL 33318-5908 USA  
 Tel 305-345-5000 Fax 305-345-5005

# TCS

Jerry L. Simmons

Communications Systems Consulting  
 Land Mobile, SCADA, & Microwave Systems  
 Tower & Path On-Site Surveys

P.O. Box 884 PH: (409) 588-3200  
 Montgomery, TX 77356 Fax: (409) 588-4434

# THE PORTABLE DEPOT, Inc.

SPECIALIZING IN GENERAL ELECTRIC PORTABLE SERVICE

- FACTORY TRAINED TECHNICIANS •
  - SURFACE MOUNT TECHNOLOGY •
  - FACTORY APPROVED NATIONWIDE •
  - PUBLIC SERVICE TRUNKING •
  - VOICE GUARD CERTIFIED •
  - MPD, MPA, TPX, PCS AND ALL CURRENT PRODUCTS •
- Route 2, Box 338C • Lynchburg VA 24501  
 804-237-3427



# BROWN AND SCHWANINGER

Attorneys At Law

1835 K Street, N.W.  
 Suite 650  
 Washington, D.C. 20006

202/223-8837

SERVING THE NEEDS OF THE ENTIRE INDUSTRY

# FREDERICK G. GRIFFIN, P.C.



3229 Waterlick Road  
 Lynchburg, VA 24502  
 (804) 237-2044

NATIONWIDE COMMUNICATIONS CONSULTING

Mobile Radio, Microwave, E9-1-1,  
 CAD, Paging, LAN,  
 Dispatch Communications Centers  
 Multi Site Propagation Analysis



OMNICON, Inc.  
 COMMUNICATIONS ENGINEERING

GENE A. BUZZI  
 PRESIDENT

930 THOMASVILLE ROAD, SUITE 200  
 TALLAHASSEE, FLORIDA 32303  
 PHONE: (904) 224-4451

# GE PORTABLE SERVICE

- FAST TURN
- WARRANTY
- \$37.00 hr./2 hr. MAX
- PARTS GE LIST
- RETURN UPS PAID



Smith Communications Service

2121 W. Parrish Ave., Owensboro, KY 42301  
 502-683-0936

# Telecomm Engineering Inc.

maxon® Portable Service

CP0500, CP1000, SP2000 Series

- Factory trained technicians
- \$50.00 flat rate plus parts
- Battery conditioning included
- Warranty • Return UPS paid

3435 Mission Ave., Carmichael, CA 95608  
 (800) 420-5166

# PORTA-TECH

PORTABLE  
 TECHNICAL  
 SERVICE, INC.

121 Crowell Lane • Lynchburg, VA 24502



FACTORY TRAINED  
 TECHNICIANS  
 FOR QUALITY SERVICE

GE Portable Radio Service Depot  
 Factory Approved Nationwide

- Current Product Lines
- Voice Guard Certified
- Public Service Trunking
- Surface Mount Technology

(804) 239-3049

# TROTT

COMMUNICATIONS GROUP

RAYMOND C. TROTT, P.E.  
 President

1425 Greenway Drive, Suite 350, Irving, Texas 75038  
 214/580-1911, Fax: 214/580-0641

# HERB SACHS, CONSULTING

Specialist in Public Safety Communications

P.O. Box 729  
 Bowie, MD 20715  
 301-464-4268

# The Warner Group

MANAGEMENT CONSULTANTS

- Radio/Microwave/E9-1-1
- CAD/Mobile Data Design & Selection
- Police/Fire/EMS
- Consolidation Studies

5950 CANOGA AVENUE, SUITE 600  
 WOODLAND HILLS, CALIF. 91367  
 (818) 710-8855



## Classified

### Professional services

#### Communications Technology Associates

A division of Hayes, Seay, Mattern & Mattern, Inc.

##### PLANNING AND DESIGN:

- 2-Way Radio
- MW & F/O
- CAD/MDT/AVL/Paging

##### PLUS:

- Complete A/E Services
- Bldgs, Towers, Pwr Sys
- Structural Engineering



Box 18041 239-9200  
FAX (804) 239-9221

P.O. Box 4579  
Lynchburg, Virginia 24502

#### MCCON

Mobile Communications Consulting  
S. R. McConoughey, P.E.  
Principal

13017 Chestnut Oak Drive  
Gaithersburg, MD 20878

(301) 926-2817

### Employment

#### TWO-WAY RADIO TECHNICIANS (2 OPENINGS)

MINIMUM SALARY

\$38,516.50 ANNUALLY

Maintains communication system and other associated equipment for the City of Memphis Police, Fire, and local government.

High school graduate or equivalent. Two years experience in land mobile two-way radio field and FCC General Class License required. Applications/resumes will be accepted March 22, 1995 through May 12, 1995.

CITY HALL, ROOM 1-B-33  
125 NORTH MID-AMERICA MALL  
MEMPHIS, TN. 38103

#### CELLULAR TWO-WAY PAGING PERSONNEL SERVICES

Technical & Engineering  
Positions Available Nationwide  
Fees client paid. Send resume to address below.

##### ALL LEVELS OF POSITIONS FILLED NATIONWIDE

- Technicians • Engineers • Managers • Sales
- Extensive national resource of personnel

Employers: Call 606-491-5410 10 AM to 8 PM



Communication Resources

P.O. Box 141397 • Cincinnati, OH 45250  
606-491-5410/FAX 606-491-4340

#### COMMUNICATIONS TECHNICIANS

The Radio Sales Company is looking for 3 Senior Techs for its Northern Nevada Operations, with positions available in Reno, Elko and Winnemucca. Field/Bench experience, min. 2yr on Motorola radio system and equip. Knowledge of RSS software. Moving Costs Paid. Complete Benefits, Commission, and Bonus package. \$35 to \$50k per year DOE. Fax resume to: 800-547-2171

#### PAGENET

Paging Network, America's largest paging company, is currently seeking the following positions in our Farmington Hills, Michigan office:  
SYSTEM TECHNICIANS

Responsibilities for this position include: installing and maintaining base stations and paging terminal equipment. At least one year experience with paging or wireless communications is required. FCC or NABER certification is preferred. Reply to: ST Pagenet offers a competitive salary and a full range of benefits. Qualified applicants should send resume/salary history to:

Pagenet-Michigan  
33533 W. 12 Mile Rd. #300  
Farmington Hills, MI 48331  
Fax: 810-488-3615

No phone calls, please.  
Principals Only

E/O/E

PROGRESSIVE MAUI HAWAII SALES AND SERVICE COMPANY SEEKS QUALIFIED TECHNICAL SPECIALIST TO SUPPORT JOHNSON MULTI-NET AND LTR SYSTEMS AS WELL AS MOTOROLA CONVENTIONAL AND PAGING PRODUCTS. SALARY COMMENSURATE WITH EXPERIENCE.

FAX RESUME TO:

HARMER COMMUNICATIONS

ATTN: ANNETTE

FAX: (808)-877-8084

### Manufacturers' reps

#### HARRISON RADIO/HARRISON CELLULAR

~since 1925~

Manufacturers' Representatives  
Wireless Communications Equipment,  
Cellular Telephones, Pagers, Commercial  
Radio Communications Equip., T&M  
Equip., components, supplies

Michael Harrison

545 8th Ave., Suite 401, NYC, NY 10118-0069  
1-800-353-6295 • 516-763-6295  
FAX: 516-823-0805 Export Inquiries Invited

## CLASSIFIEDS

### PLACING YOUR CLASSIFIED AD IS AS EASY AS...

#### Fax

Scott Thompson  
Classified Ad Manager  
(913) 967-1735

#### Phone

Scott Thompson  
Classified Ad Manager  
(800) 771-3351  
(913) 967-1923

#### Mail

Mail your ad materials to:  
Tammy Kalebaugh  
Advertising Coordinator  
9800 Metcalf Ave.  
Overland Park, KS 66212-2215



Scott Thompson

#### Classified Ad Index

Business Opportunity .....	pg 108
Computer Software .....	pg 113-115
Employment .....	pg 96
Equipment For Sale .....	pg 99-107
Equipment Wanted .....	pg 108
Manufacturers' Reps. ....	pg 96
Pager Repairs .....	pg 99
Paging .....	pg 97-99
Prof. Consulting Services .	pg 97
Professional Services .....	pg 95,96
Rentals .....	pg 108
Repair Services .....	pg 110,111
Services .....	pg 110
Technicians Available .....	pg 97
Tower Services .....	pg 109,110
Tower Space .....	pg 108,109

### Employment

Communication Tower Personnel needed for expanding company. Must be experienced in Two-Way, Microwave and Cellular installations including some tower erection, electrical and trouble-shooting. Positions available for Superintendent and Technicians. Send resume to:

Lumberton Tower Service  
P.O. Box 8220, Lumberton, Texas 77657

#### MOTOROLA AUTHORIZED DEALER SALES & SERVICE

#### TECHNICIAN WANTED

Forty year old MSS/Full Line Dealer is seeking a Technician with good people skills. Must have a minimum of 3 years experience with fixed and mobile equipment, installation, maintenance, and component level repair of Motorola equipment. Knowledge of Motorola 800Mhz trunking systems both fixed and mobile. Send resume with salary requirements to:

MRT, Dept # 939

9800 Metcalf

Overland Park, Ks 66212

#### TEXAS OPPORTUNITY

2-WAY SALES & SERVICE, UHF PRIVATE CARRIER REPEATERS, PRIVATE CARRIER PAGING, CELLULAR AGENT. ANNUAL GROSS SALES 750K. LOCATED IN URBAN AREA NEAR TEXAS COAST. RESPOND TO: MRT/ DEPT. # 940  
9800 METCALF  
OVERLAND PARK, KS 66212



## Classified

### Professional consulting services

**FOR LEASE**  
470 MHz exclusive use  
Private Carrier 2-way channels  
in the Los Angeles area  
FAX confidential replies to:  
Scott Thompson c/o MRT Box #938  
913/967-1735

#### FLAT FEE ENGINEERING SERVICES

HAAT's, Profiling, Coverage  
Carey, Bullington, Longley-Rice  
Contact: Jim Hart, P.E.  
(303) 795-2813 FAX (303) 347-2652  
**HartTech, Inc.**  
PO Box 88  
Littleton, Colorado 80180

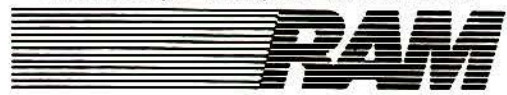
Reach  
over  
24,000  
prospects  
every  
month  
in  
MRT  
Classifieds

### Paging

#### COMMUNICATIONS CONSULTING SERVICES

- ☑ Mobile Radio Systems
- ☑ Mobile/Portable Data Systems
- ☑ Computer Aided Dispatch Systems
- ☑ Basic And Enhanced 9-1-1 Systems
- ☑ Telephone Networks
- ☑ Microwave Radio Systems
- ☑ Vehicle Location Systems
- ☑ Fiber Optic/PCM Transmission Systems
- ☑ Full GIS Services

#### PLANNING, DESIGN, IMPLEMENTATION



10 Woodbridge Center Drive  
Woodbridge, NJ 07095  
(908) 636-6970  
Toll-Free: (800) 247-4796 • FAX: (908) 636-7260

#### COMMUNICATIONS CONSULTANTS, INC.

Offices throughout the United States and London, England;  
Melbourne, Australia; Richmond, B.C. Canada.

Circle (110) on Reply Card

### Technicians available

#### ▼ TECHNICIANS AVAILABLE ▼

Mobile Communication Technician graduates from our two year program. Will be available for employment June 2, 1995. Intensive hands-on training includes Micro-processors, Two-way equipment, Cellular, Paging, Trunking and R.F. test instruments.  
★ Industry Certified Graduates  
★ Graduates placed all over 48 States, and Alaska, since 1967.  
Visit us at our IWCE Booth  
Call: Roger Williams, Instructor or Fred Hanson, Placement Coordinator  
**WILLMAR TECHNICAL COLLEGE**

### Paging

#### USED PAGERS

Motorola and NEC. Reconditioned on your channel w/warranty, or "as is"

**ACS** (303) 337-4811  
FAX (303) 337-3084

#### RICTRONIC 9300A PAGER MULTI-FORMAT ENCODER

\*Standard POSAGE encoding format 512 & 1200bps  
\*Message format - tone, numeric, alphanumeric or Chinese  
\*Easy operate \*Portable \*Lowest price  
Tel: (852) 359-3139 Fax: (852) 384-4366  
**HUNG TO DEVELOPMENT  
COMPANY**

**MAKE YOUR AD  
STAND OUT...  
USE COLOR!**

## CRYSTALS & PARTS

1400+ FREQS OF TOP QUALITY CRYSTALS AVAILABLE FOR IMMEDIATE DELIVERY  
COMPETITIVE PRICES ♦ LIFETIME WARRANTY ♦ HASSLE FREE REPLACEMENT

## CRYSTRONICS

FOR YOUR PARTS AND ACCESSORY NEEDS WE PRESENT OUR NEW DIVISION...

## PAGER PARTS UNLIMITED

VIB MOTORS FOR ALL PAGERS. LCD'S FOR BRAVO, PLUS & EXPRESS PAGERS. 28 ATTRACTIVE COLORS IN HIGH QUALITY POLYCARBONATE HOUSINGS, HOLSTERS, CLIPS, SWITCHES AND BATTERY COVERS. 7 ATTRACTIVE COLORS IN VINYL CASES. NEW ITEM: MEMO EXPRESS HOLSTERS

PH: (305) 776-0031 ♦ FAX: (305) 776-0109



Circle (111) on Reply Card

## DuraComm®

### 2 Channel Tone & Voice Monitor Pager



- ☑ VHF/UHF/Low Band
- ☑ PC Programmable Tones
- ☑ Multi-Addressable
- ☑ Scan Feature with Priority
- ☑ DurAlert, Full Accessories
- ☑ High Dealer Margin

#### DuraComm Corp.

Kansas City, MO  
1-800-467-6741 • FAX 816-741-7499

Circle (112) on Reply Card



Paging



# QUALITY USED PAGERS LOW BAND VHF/UHF & 900Mhz

We Now Offer A Full Line of Motorola Cellular Phones . . . ETACS, GSM!



**MOTOROLA**

PANADATA 4000

**NEC**

IDP 7000

**BRAVO**

IDP 5000

**ENVOY**

PMR 2000 ALPHANUMERIC

D3 FRONT DISPLAY

**D4N  
A & C  
STYLE**

**SPIRIT**

**BRAVO TONE**

BRAVO ALPHANUMERIC



## FOURTH DIMENSION INDUSTRY, INC.

Wireless Communications Equipment Broker

331G Dante Court • Holbrook, NY 11741

516/467-1220 • Fax: 516/467-1645 • Toll Free: 800/378-0348



Circle (113) on Reply Card

• PAGERS • PAGERS • PAGERS • PAGERS • PAGERS • PAGERS •

### NEW & RECONDITIONED MOTOROLA & NEC PAGERS

- Motorola & NEC Factory Replacement Housings & Parts
- Vib Motors
- NEC Motorola 6, 7, & 10mm Sizes

**McManus Communications**

400 N. 5th St., Blytheville, AR 72315

Tel: 501/763-6250 Fax: 501/763-6533

### USED PAGERS WANTED!

### PAGER REPAIRS

- Recrystalling
- LCD replacement
- Fast turnaround



• PAGERS • PAGERS • PAGERS • PAGERS • PAGERS • PAGERS •

Circle (114) on Reply Card

## Mobile Radio Technology

Call Scott Thompson Today  
for more information  
800-771-3351  
(913) 967-1923  
Fax: (913) 967-1735

### PAGER REPAIR LABELS IN 2 SECONDS

(CAP CODE, BAR CODE, frequency, & reward)  
Software, printers, scanners, labels,  
and SYSTEMS

#### ADVANCE LABEL & TAG

1725 N. McDonald McKinney TX 75069 ♦ 1-800-466-5345  
FAX 214-548-2518

## PAGER CRYSTALS

**LCD'S • PASSWORD  
BREAKERS**

### MOTOROLA BRAVO SERIES

ORIGINAL PRODUCT QUALITY  
Pacific Standard 1-800-957-8700  
Mon-Fri. 8-5 p.m.

PCI Pagecorp Industries



## Classified

### Paging



#### PAGER SALES | PAGER REPAIR

- Refurbished Motorola & NEC Pagers
- 90 day guarantee\*
- Volume discounts

\*Guarantee on electronic components only.



- Fast turnaround
- Flat rate labor\*
- Common frequencies in stock
- Parts & accessories

\*Flat rate does not include parts

# 1-800-844-8287

#### Kern Pager Repair

834 Foley St. Jackson, MS 39202  
601-357-4138 Fax: 601-948-8257

Circle (115) on Reply Card



#### SENTRY MANUFACTURING COMPANY

##### PAGER & RADIO CRYSTALS

# 800-252-6780

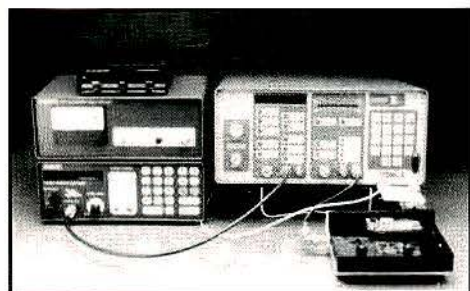
28 Years in the Crystal Business • Customer Service Second to None  
100% Quality Control Tested • No-Hassle Lifetime Warranty  
Very Large Stock of Pager Crystals • Overnight Shipping Available  
Scheduled Shipments & Purchase Agreements Arranged  
Channel Elements & Tone Reeds Also Available

**Sentry Crystals Are "Rock" Solid TVB**

Circle (116) on Reply Card

### Equipment for sale

## Complete Pager Testing...



- ▶ All Popular Pagers
- ▶ Pocsag, Golay, & NEC
- ▶ 512 to 2400 Baud Rates (upgradable to Flex)
- ▶ Alignment & Sensitivity
- ▶ Fast Verification of Re-Crystallizing Jobs

**Includes...** COM-3 Communications Service Monitor (\$2995.00), COM-6 Universal Encoder (\$995), RTF-1 Radiation Test Fixture (\$465), CT-125 Frequency Counter (\$190), SM-1 Automatic SINAD Meter (\$250), all interconnect cables, shipment to your door, and a quick hook-up guide for fast set-up and immediate profitability! Shipments going daily!  
**Complete package only \$4995.** Leasing available. Call now to get yours en-route.

**RAMSEY ELECTRONICS, INC.**

793 Canning Parkway, Victor, NY 14564



**CALL 1-800-446-2295**

**FAX 1-716-924-4555**

Circle (117) on Reply Card

### Pager Repairs

Motorola, NEC, Shinwa, GE and Relm

## Pager, Portable Sales & Repair



Clean, Repair, Tune,  
Align to Factory Specs

Customer Service & Sales

**1-800-725-1426**

Fax

**1-800-322-9426**

P.O. Box 26330, 10 N. Lee, Oklahoma City, OK 73126-0330

## DPR, INC.

### Custom refurbishing

Recycle your pager housings  
in over 40 colors with  
matching color buttons.

Replacement lenses for  
Bravos, Advisors and  
NEC Relays.

### Component level repair

Low flat rates  
Quick turn-around  
Professional & Reliable

Major credit cards accepted.

# 800-460-1377

San Antonio, TX

Circle (118) on Reply Card

### Equipment for sale

## CAL CRYSTAL LAB., INC.

### CRYSTALS FOR ALL RADIOS

- ♦ Communication Crystals  
All makes and models

- ♦ Channel Elements  
Recrystallized and compensated

**Competitive pricing!**

**Emergency Service**

For Crystals 24 Hours • 72 Hours • 1 Week  
Normal Delivery 3 Weeks

**800-333-9825**

FAX 714-491-9825

1142 N. Gilbert Anaheim, CA 92801



Equipment for sale



Mailing Address:  
P.O. Box 7846  
Fredericksburg, VA 22404  
3605 Loran Whitney Drive  
Massaponax Business Park  
Fredericksburg, VA 22408

Spectratrac RX, LB, HB, UHF  
Spectratrac Comparators Clear and Secure Bases  
C71RCB3106, 30-36, 100W, PL, Tone  
C71RTB3106, 42-50, 110W, PL, Tone  
B91RCB3106, 42-50, 330W, PL, Tone  
VC94TAU33, 42-50, 330W, Mastr II  
C73RXB3106, 110W, CD, DES, Highband  
Centracom I & II's  
B83RCB3106, 250W, CD, PL

C64RCB3106, 75W, CD, 450-470 Repeater  
Miscellaneous Remote Controls  
T1600, T1900, T1380's Series Remote Control  
EMS Base Controls  
DB Products Cube Filter Combiner, 800 Mhz  
TXRX Combiner VHF  
Sinclair VHF Combiners  
Vertex Products Available

Many items in stock, call with your requirements.  
We have the R1801 DAC for your programming needs. Call us with your requests.

Phone: (703) 891-0569 We accept VISA and Mastercard Fax: (703) 891-0538

Circle (119) on Reply Card

## CLEAN USED GEAR

Cushman CE-4 & CE-6 Service Monitors  
GE Phoenix SX VHF, 2/16 CH & Scan  
GE MLS LB, VHF, UHF 2/8/16 CH & Scan  
GE MASTR II & Exec II LB, VHF, UHF  
GE MVP, VHF  
GE MASTR II Base/Rptr LB, VHF, UHF  
Motorola Mocom, Micor, Mitrek LB, VHF, UHF  
Motorola Mox, Maxar, -50, -80 LB, VHF, UHF  
Motorola Mostar 800T  
Motorola Base/Rptr/Consolelets LB, VHF, UHF  
Standard GX3000 VHF, UHF 64 CH Synth/Scan  
Standard 966L LB, 75 Watt, Synth  
Mostar VHF, Maxtrac 900 Mhz

NEW STANDARD RADIOS AT DISCOUNT! CALL NOW  
Harris Alpha 2000E VHF IMTS  
Motorola Pulsar VHF IMTS & Others  
Motorola MT500 LB, VHF, UHF HT  
Motorola MT/HT/ Gang Chargers  
Standard HX300, 320, 734, 834 VHF, UHF HT  
Standard HX400 VHF, UHF 25 CH Synth 5W HT  
Uniden SPH & SPU 8 CH Synth HT  
Wescam 2 GHz Microwave, MUX  
Standard GX-1500U  
GE Deskon II DC Remotes, Motorola Local Remotes  
MORE - MORE - MORE - MORE - MORE - MORE

**VersaTel**

We Buy Used Equipment - CALL!  
Ph: 1-800-456-5548  
Fax: 1-307-266-3010

Circle (120) on Reply Card

• MOBILES • BASES • PORTABLES • PAGERS • REMOTES •

### PCI — PEKAAR COMMUNICATION INC.

Steve's back, formerly of Gregory Electronics Corp.

\$ Specials of the month. \$

GE Phoenix SX Model N5HH1W40PB highband w/dual priority scan & accs. SPECIAL \$250  
GE Delta S Model N3CC3N 110TB 110 watt 36 to 42 range w/accs. \$150  
Federal Mobile Model MP74110 underdash 42-50 range w/accs. \$125  
Motorola Mitrek Model T51JJA 2800 50 watt 42-50 range 4 freq. with accessories, clean, no PL \$150  
Motorola MOCOM 70 U41BBA 1900 60 watt 42-50 range 4 freq. w/accs., clean, no PL \$65  
Motorola Micor U51RTN1100 42-50 50 watt w/acc., no PL \$125  
GE MPE Portable Model P665RBWBMX 450 to 470 range, 2 freq. w/CG \$65  
GE PE Portables Model P665RBW 450 to 470 range, 2 freq. w/CG \$75  
Motorola Handicom chgrs for MH10 Model NLN8005N \$20  
GE Exec 1 Special Hiband/Lowband Complete Radio w/case, spur, cable & cntrl. head AS IS \$20  
Celec Vega Mobile Decoders #324 \$6  
Motorola Model N1244A ConventaCom chgrs for MX Portables \$5  
Federal Sirens Model PA 300 \$45  
GE Exec II Control Heads \$5  
Motorola Micor Mobiles T45RTA5800AA 800 Mhz range less acc. & cases \$25

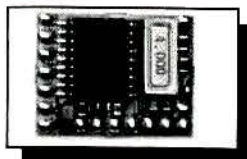
Catalog Available If you can't find it, try us! Call (201) 772-0704

• BOARDS • STRIPS • ACCESSORIES • ELEMENTS • REEDS •

Circle (121) on Reply Card

## Trunk Motorola Radius Radios

- New, low cost trunking logic
- No special site controller required
- All features software controlled
- Dispatch and interconnect capable
- Detailed installation instructions
- Only 0.8"L x 0.68"W x 0.13"H



Shown Actual Size

**ETRUNK SYSTEMS, INC.**

1803 Commerce Street, Yorktown Heights, NY 10598 USA  
Voice: (800) 438-7865 International Voice: (914) 245-1128  
Fax: (914) 245-2382 Fax Back System: (800) 292-9723

from...  
**\$39**

Circle (122) on Reply Card

**WE'LL BEAT YOUR BEST PRICE!**  
**California Radio 800-231-0103**

### R&R USED RADIO 1-216-759-1755

#### Portable

Uniden APU w/case, batt, chgr ..... \$75-\$100  
Maxon CP0520/H0, chgr ..... \$50-\$100  
Motorola HT-90 VHF/UHF ..... \$75  
P100 6 bay chgr (rapid) ..... \$125  
MPI 2W/2ch ..... ?

#### Mobile

GE Mstr II low, V, U w/ accs ..... \$125  
GE Exec II low, V ..... \$100  
GE Phoenix SX UHF ..... \$150  
Motorola Mox VHF ..... \$50  
Motorola Micor UHF ..... \$100  
Motorola Micor VHF T73 ..... \$100  
Motorola Mitrek UHF T64 w/accs ..... \$100  
Motorola Mitrek VHF T83 ..... \$150  
Standard C768L UHF ..... \$125

#### Pagers

Motorola Director II UHF ..... \$125  
Motorola Dimension IV w/chgr ..... \$30  
Motorola BPR2000 T/V ..... \$30  
Motorola Monitor I VHF ..... \$75  
NEC VHF/chgr amp ..... \$50  
Zetron Model 15 encoder ..... \$150  
Ccm spec PE 1000 encoder ..... \$100

#### Bases

Motorola Micor 42-50 330 W ..... \$1500  
Motorola Flexar UHF ..... \$150  
GE 30-36 330W ..... \$1500  
GE 30-36 MHz 330watt ..... \$1500

#### Other

Call forwarding adapters ..... \$25  
Scanners, REMotes, RCA accy's ..... Call  
5 Maxtrac 800 MHz D3485 w/ accy's ..... \$325  
4 Motorola MX 340 w/mic/case ..... \$35

**S. P. U.** 100 Arnold Lane  
Paragould, AR 72450  
(801)239-9605

48" HEAVY DUTY ANTENNA  
SIDE MOUNT  
DEALER \$289.20  
Also available 18" Heavy Duty  
Antenna Side Mount Dealer \$139.80

• MOBILES • CENTRA COMM II • BASE STATIONS •

MOTOROLA SYNTOR X 9000 50MHz 110W  
LOW BAND ..... \$500.00

CENTRA COMM II DISPATCH  
CONSOLE IN STEEL CABINETS  
(CEB NOT INCLUDED) ..... \$1,500.00

MOTOROLA T-1605 REMOTE  
CONTROL UNITS ..... \$250.00

MOTOROLA MICOR 100W BASE  
STATIONS ..... \$600.00

CONTACT DAVE COLLINS (517) 788-2967  
FAX (517) 788-0769  
CONSUMERS POWER CO.  
115 W. TRAIL ST., JACKSON, MI 49203

**! NOTICE !**

CALIFORNIA RADIO  
has **LOWERED** ALL Motorola  
**Radius** Radio Prices!  
Your BEST deal = 800-231-0103



## MULTIPLEX - TWO-WAY RADIO - MISC.

20 Lenkurt 46A modern	\$100
60 GTE Lenkurt 3612 Channel Modems	\$50 ea.
50 Motorola MC 400 MLN 6153 Channel Modems	\$100 ea.
50 MC 400 Term Cards	\$50 ea.
3 Micor Base Stations, 100W 42-50	\$950 ea.
2 GE Mastr II Base Stations, 100W 42-50	\$950 ea.
6 Motorola Syntor X Trunked, Smart-Net, Dual Operation Control Station, NEW	\$400 ea.
1 Modax 500	\$400 ea.
20 Micors 45W Sys. 90 Scan, Multi-PL	\$100 ea.
20 MO 70s, 42-50 PL 100W w/Acc.	\$100 ea.
20 MT 500 UHF PL 5W 8 Ch. w/Charger	\$100 ea.
20 MX 300 S 8 Ch. Multi PL w/Charger	\$125 ea.
3 Syntor XX 100W UHF	\$400 ea.
1 Syntor XX 100W 30-50 MHz	\$400 ea.
10 T1605 w/mic's	\$150 ea.

Call Charles at CMC Enterprises, 910/769-2885

## WE BUY AND SELL USED MOTOROLA AND GE FM TWO-WAY RADIOS

## SCHAEFER RADIO CO.

130 West  
Fayette St.,  
P.O. Box 395  
Denver, IA  
50622

PHONE:  
(319)  
984-6115  
FAX:  
(319)  
984-6220

1 ea. SPECTRA Base, 900 MHz, D37KGA5J87FK	
2 ea. SPECTRA, 900 MHz, D37KGA5J85EK	
4 ea. MTX900, 900 MHz, H25HFF51838N	
2 ea. MTX900, 900 MHz, H25HFF51818N	
3 ea. MICOR Comm. Rpt., 800 MHz, C75R2B61058Y	
6 ea. SYNTOR X 9000, 460 MHz, T74KEJ7J04	
38 ea. SYNTOR X 9000, 460 MHz, T34KEJ7J04	
14 ea. MAXAR 80, 460 MHz, D34TS46300	
2 ea. APCOR Portables, 460 MHz, P24ESN3150SP	
3 ea. GE Phenax-SX, 460 MHz, NS411	
10 ea. MX340, 460 MHz, H44AU3140	
11 ea. MT500, 460 MHz, H348BU3124	
30 ea. SYNTOR, 155 MHz, T83SRA3200	
48 ea. MITREK, 153 MHz, T83JA3900	
6 ea. MITREK, 153 MHz, T43JA3000	
18 ea. MICOR, 153 MHz, T73RTN3100	
2 ea. MX350, 155 MHz, H43AU3140	
2 ea. MICOR Bases, 47 MHz, C71RTB3406	
4 ea. MARATRAC, 47 MHz, T81XTA77A7BK	
46 ea. MITREK, 47 MHz, T81JA4000	
8 ea. MITREK, 48 MHz, T51JA4900	
25 ea. MICOR, 47 MHz, T71RTN3100	
1 ea. GE Custom MVP, 47 MHz, C754AAU33A	
1 ea. MICOR BASE, 37 MHz, C71RTB1406	
15 ea. MITREK, 31 MHz, T81JA4000	
75 ea. MOCOM 70, 37 MHz, T51BNH100	
21 ea. Tone Remote Consoles, T1604M	
60 ea. Tone and DC Remote Desk Sets, Mixed Models: T1926, T1380, T1902	
14 ea. Local Control Desk Sets, T1370	
56 ea. SYNTOR X 9000 Control Heads, HCN1033A	
4 ea. CENTRACOM I Single Bay Tone Remote, MCM w/T&R Modules	
5 ea. CENTRACOM Empty Cabinets	
2 ea. "DVP" Code Programmers, P1001BX	
25 Sets MOTRAC Accessories	
26 ea. GE MASTR PRD 6 ft. Indoor Cabinets	
68 ea. GE PE 3 Hr. Chrgs., 3513AIX	
12 ea. GE PE 14 Hr. Chrgs., 3511AIX	
14 ea. HT220 Slimline Rapid Chrgs., NLN6395	
18 ea. MT500 Slimline Rapid Chrgs., NLN4565	
15 ea. HT220 Omni Std. Chrgs., NLN6804	
13 ea. MT500 Omni Std. Chrgs., NLN4561	
6 ea. MT500 Omni Vehicular Chrgs., NLN6892	
8 ea. PULSAR II VHF IMTS Phones, Mixed Models	

## OVERSTOCK

Motorola Batteries & Chargers-new in boxes  
NTN-5538B P200/HT600/MT1000  
Rapid charger ..... \$30.00 ea.  
HNN-9628A Hi-Capacity  
GP300 Batteries...\$40.00 ea.  
6-piece minimum quantity orders (mixed)  
**R-CAL CORP**  
800-447-7368

**Radius**  
Lowest prices PERIOD!  
CALIFORNIA RADIO 800-231-0103

## Equipment for sale

## RF POWER AMPS

### PAGING & COMMUNICATIONS

### VHF/UHF 800/900 MHz

Features: Protection of; VSWR  
over/under drive, & temperature.  
Front panel FWD/REF power meter.  
Quiet triple fan cooling.

Designed for continuous duty, and  
backed by our 2 year limited parts  
and labor warranty that even covers  
shipping via UPS GROUND.

CALL US... 1-800-LH AMP 4U

310-865-4923 So. Calif.  
FAX: 310-865-9413

Circle (123) on Reply Card

(800)726-9015 (612)884-8352

- We Have Fast Service.
- We Have a Flat Rate Repair Service.
- We Have a Complete Dealer Support Program.
- We Have a Large Variety of Accessory  
Items Available

Wholesale Prices to  
Dealers Only

**RADIO  
COMMUNICATIONS  
WHOLESALE**

Circle (125) on Reply Card

# Hy-Q

International (USA)

- **PAGER CRYSTALS**
- **COMMUNICATION CRYSTALS**
- **CHANNEL ELEMENTS**

- **Recrsyalled**
- **Complete Elements**

## 48-HOUR SERVICE AVAILABLE

(606) 283-5000  
FAX: 1-606-283-0883

1438 Cox Ave., Erlanger, KY 41018  
(Greater Cincinnati Area)

"Precision Quality Quartz Crystals —  
Made to your Specifications"

Circle (124) on Reply Card

NOW Featuring **TEKK**

Portables!

Our Prices will Surprise  
You Even if You Buy Direct  
from the Factory!!!

- ★ **Full Line Distributor of Tekk**
- ★ Many other brands also available.
- ★ Your One Stop Warehouse for All Your  
Communications Equipment Needs.

24 Hour a Day FAX  
(612)884-8356

**AF Comm Supply**

1-800-255-6222

Formerly Antenna Farm Communications Supply

## CELWAVE

DIVISION OF RADIO FREQUENCY SYSTEMS

The Celwave PD10183.

It's the top performing, pattern constant  
throughout the band, 187 mph wind  
rating, transposed dipole array, copper  
radiating elements enclosed in a rigid  
fiberglass radome.

- ◆ **In Stock**
- ◆ **Competitive Prices**
- ◆ **Best Service**

Circle (126) on Reply Card



**Equipment for sale**

# IS YOUR SYSTEM A MAZE?

Find your way out with AEE's new line of Updating Tone Controls

- Compatible with all conventional radio systems
- Synchronized Seven Segment Channel Display
- Power Failure Indicator
- Parallel Transmit & Intercom Indicator
- Supervisory Lock Out



CALL FOR ADDITIONAL DETAILS & PRICING

Automation &  
Electronics  
Engineering, Inc.

13667 FLOYD CIRCLE • DALLAS, TEXAS • (800) 527-4596 • (214) 238-9596 • FAX (214) 238-9181

Circle (127) on Reply Card

Now, here's a switch!

## CHARGE GUARD®

automatic [ON/OFF] timer switch  
for two-way radios, cellular phones

**EASY TO INSTALL.**

NO IGNITION SWITCH CONNECTION!

**PROGRAMMABLE.**

15 MINUTES TO 15 HOURS!!

**Prevents Dead Batteries.**

MADE IN U.S.A.

PROTECTS YOUR RADIO.

SUGGESTED LIST ONLY \$74.95 MODEL CG18-12N  
12 AND 24 VOLT MODELS AVAILABLE

CALL NOW FOR MORE INFORMATION!

ASK ABOUT  
OUR NEW  
DEALER KIT!!



**CHARGE GUARD**

400 Highland Avenue  
Alltoona, PA 16602

**800-458-3410**

1991 ChargeGuard

Circle (128) on Reply Card

## BUY - SELL RADIOS

NEW & USED

Johnson - Motorola

Standard - Uniden

**Buy-Comm-Co.**

Steven Kenney

**1-800-347-4121**

(602) 585-3900

FAX (602) 585-6900

29669 North 45th Street  
Cave Creek, Arizona 85331

**RADIUS SP50**  
IN STOCK &  
ON SALE  
ALL MODELS



**UHF**

From \$329

**VHF**

From \$301

Call For Volume Discounts



**SAFARI  
RADIO**

Motorola 2-Way Radio Sales

**1-800-RADIO-80**

## TPS

**POWER SUPPLIES**



**75 AMPS**

Continuous Duty

**9 POUNDS**

- LOW RIPPLE •
- CURRENT LIMITED •
- FILTERED •
- REGULATED •
- EFFICIENT •
- MOV PROTECTED •

7 TO 75 AMP MODELS AVAILABLE

**DuraComm Corporation**

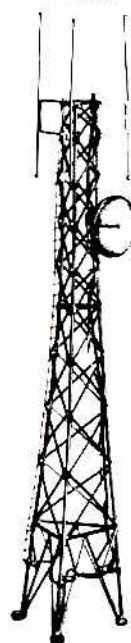
438 NW BUSINESS PARK LANE

KANSAS CITY, MO 64150

1-800-467-6741

Fax 1-816-741-7499

## TOWER LITE OUT?



Don't worry...

The Bramco

Tower Lite

Monitor

Will Phone You

and

Tell You About It!

**Signaling and**

**Control Is**

**Our Business.**



**Bramco, Inc.** 513-773-6255  
Piqua, OH Fax: 773-8003

Circle (129) on Reply Card

## New / Used Reconditioned 2-WAY RADIOS

- Purc's, repeaters, base stations, mobiles & portables
- LB's / VHF / UHF / 800-900 MHz
- Large inventory of late model equipment

Call for quote

We pay the highest prices!

**SCOTT COMMUNICATIONS**

Ken Scott

406-745-3218



Equipment for sale

# MOTOROLA Radius

CALL NOW for HUGE  
INVENTORY REDUCTION  
SALE ON:  
VISARS, MTX 8000 &  
9000's SPECTRAS,  
MINITOR II's, AND PRIVACY  
PLUS MOBILES.  
ALL FROM OUR DEMO FLEET  
**1-800-249-1250**  
WETEC ELECTRONICS  
VISA ACCEPTED

Circle (130) on Reply Card

# 2-WAY RADIOS

BEST PRICES IN THE U.S.A.!



Motorola  
Radius  
and More!

Same Day Shipment  
Complete Support Program  
Nationwide Distribution

We will BEAT all other verified prices -  
**GUARANTEED!**



**1-800-521-2468**

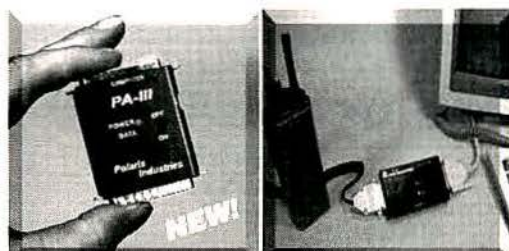
FAX - 913-234-3584



Circle (132) on Reply Card

## Chicago AutoWerks Inc.

Used Fujitsu Mobile Radios  
450-469 Band  
Great Prices- Call Today  
312-421-4060  
Ask for Art



Program Your Radios "IN-HOUSE"

FAST - SAME DAY SHIPPING  
**1-800-752-3571**

24 HOUR FAX LINE 404-252-8929

### Full Line of Programming Cables Available

Our Programming Cables are precision devices designed specifically for each radio. Put your confidence in our quality.  
NEW! HT1000/MT2000/JEDI..... CALL  
VISAR..... \$119

GP300 / P110, HT50 / P100, STX, STX Gemini, STX 821,  
SPECTRA, RADIUS @ MOBILES, MAXTRAC @, and more!

Prices Subject to Change Without Notice

### COMPATIBLE MOTOROLA® RADIO PROGRAMMING EQUIPMENT

#### PA-3\* POCKET PROGRAMMER...\$169.95

- Micro-Size Design for Convenient Portability and Field Use.
- Uses Surface Mount Technology (SMT).
- Rechargeable - Works for Hours on One Charge.
- Supports Full Spectrum of Programmable Motorola® Radios.
- Includes AC Adaptor, XT/AT cable, Serial cable, 1 Year Warranty.

#### PA-2\* Programming Adaptor...\$129.95

#### PA-1\* Programming Adaptor.....\$99.00

CALL FOR A FREE  
FULL COLOR BROCHURE ON  
ALL OF OUR PRODUCTS.

### POLARIS INDUSTRIES

a Division of Southern Computer Corp.

141 W. Wieuka Rd., Suite 300-B

Atlanta, GA 30342-3219

Established 1983 in Atlanta, GA

\*Note: Hardware  
Only. Software sold  
by Motorola, Inc.  
Motorola® and  
other products, are  
Trademarks of  
Motorola, Inc.



Circle (131) on Reply Card

## Natural Voice Playback



Add a recorded natural voice to your system. Voice libraries of up to 255 words or phrases (2 min total max)-record your own using our optional SDS-1000 development system and your IBM compatible, or we'll prerecord your messages for you. Eprom voice storage means your library is unaffected by power loss.

Used In:

- Repeater identifiers
- Site alarms
- ANI encoding
- Remote telemetry
- ATM's
- Multiple languages
- Emergency announce-ments

Parallel input word select  
500 ma keyline output  
32 Kb sampling rate  
Multiple modes  
Selectable timing

8 or 600 ohm audio out  
+9v to +14v supply  
Size: 3" x 4.5"  
Connectors included



Several different models available

### Palomar Telecom, Inc.

120 Simpson Way • Escondido, CA • 92029  
619-746-7998 • FAX: 619-746-1610



Equipment for sale

# WEST COAST RADIO

Join Our  
"NATIONAL RADIO BUYERS  
ASSOCIATION"

## AB\$OLUTE LOWE\$T RADIU\$ PRICE\$!

**Orders**  
800-881-6722

Info 310-268-2464  
Fax 310-268-2474



Circle (133) on Reply Card

## MOTOROLA Radius DELIVERY NOW!

One of the largest stocks of Motorola Radius in the world.  
Every Model in Stock! Free Programming of all new units on Delivery!  
Will Positively Be Shipped Tonight!

On your jobsite tomorrow. We can handle any size order and have  
done so for 21 years.

**CALL 1-800-53-RADIO (72346)**

**(706) 561-7000 FAX (706) 568-4506**

To place your order, even if you live in Hawaii, Virgin Islands, Alaska or  
Puerto Rico. **RADIO WHOLESALER - John Cunningham WB4-JUN.**

Circle (134) on Reply Card

### ELECTRONICS CENTER

3913 BROADDUS AVE. • EL PASO, TX 79904

BUYING LATE MODEL TWO WAY EQUIPMENT,  
PREFERABLY PROGRAMMABLE.

Send or Fax Your List.

We also sell used two way equipment and  
computers — some listed below.

- 55 ea.—A03JVC2468 Spirits NEW 152.240 \$20
- 11- MC65KAS88 Mastr II 75w w/acc \$292
- 44 T71RTN1400 Micor 100w 42-50 w/acc \$172
- 25 T73RTN1490 Micor 100w 150-162 w/acc \$192
- 2 TEK5130N Scope D11 SB storage 5A20N  
DA 5810 TBA \$192
- 1 TEK454 Scope 150 Mhz Dual Trace \$492
- 3 Cushman 302 FM deviation meters \$142
- 2 Cushman 303 broad band mixer \$142
- 3 TEK2246 100 Mhz Oscilloscope w/probe -  
& manual \$1492
- 1 RM561A TEK Scope 10Mhz w/TB67 &  
3A75 plugs \$329
- 1 T935 Tektronix Scope 35 Mhz \$292
- 17 T81JJA4000 100 w Mitrek 42-50 w/acc \$329
- 5 STX convertacoms w/ PA, MIC, cables like new \$292
- 1 TRW & 2 optimat fiber optics splice kit \$92
- 10 GE recording voltmeters \$29
- 1 HP180 & 1 HP181 scope 50 Mhz w/ plug ins \$392
- WE ACCEPT MC, VISA, DISCOVER & AMEXP
- Voice: 915-562-1000 • Fax: 915-562-3827

### Call Scott Thompson Today

1-800-771-3351

### NOBODY BEATS OUR PRICES & DELIVERY!

WE HAVE SENSATIONALLY LOW UNBEATABLE RADIO PRICES FOR **Radius** WE HAVE TONS IN STOCK FOR IMMEDIATE SHIPMENT!!!

PORTABLES FROM \$160. MOBILES FROM \$275. SPECIAL! GP300 8F UHF \$515.

\*\*\*\*\*  
MOTOROLA TYPE CLEAN NEW & USED TRUNKED RADIOS

PORTABLES		MOBILES (USED)	
VISAR W/CHARGER HC BATTERY	\$795	MOSTAR WITH ACCESSORIES	\$295
MTX900 6 SYS CHARGER	\$695	TRAXAR WITH ACCESSORIES	\$195
MTX9000 W/CHARGER	\$795	MAXTRAC 800 W/ACCESSORIES	\$495
MTX8000 W/CHARGER 15 SYS.	\$795	STANDARD GX5810T W/ANT	\$550
MTX800 1 SYS CHARGER	\$595	MAXTRAC 900 W/ACCESSORIES	\$795
MTX810 2 SYS CLASSIC CHARGER	\$695	SPECTRA 900 W/ACCESSORIES	\$795
HX581T 7 SYS CHARGER 3 YR WARR	\$795	PP1000X 800 W/ACCESSORIES	\$695
HX580T - 10 SYS CHARGER SCAN TEL	\$895	SYNTRON X2 W/ACCESSORIES	\$195
STX PRIVACY PLUS 3W	\$895	STANDARD GX3030T	\$695
STX SMARTNET 1,1,1,1,1	\$1,495	MAXTRAC-DUPLEX B6	\$795

\*\*\*\*\*  
MOTOROLA CLEAN CONVENTIONAL RADIOS

MT2000 160F CHARGER FROM	\$995	SYNTRON X 100W VHF & UHF FROM	\$495
HT1600/P200 5W 6F FROM	\$495	MARATAC 100W LB. VHF, UHF FROM	\$1195
HT1000 16F W/CHARGER FROM	\$695	SPECTRA A4 45W VHF & UHF FROM	\$1295
VISAR 16F W/CHARGER FROM	\$750	SPECTRA A4 110W VHF & UHF FROM	\$1795

\*\*\*\*\*  
SYNTRON X 9000 100W 30-50Mhz ALPHA-NUMERIC SCAN \$1,595

**RADIO EXPRESS, INC.** "AMERICA'S FAVORITE RADIO SUPPLIER"

ORDERS: 800-545-7748 INQUIRIES: 703-266-1928 FAX: 703-830-8710  
VISA - MASTERCARD - DISCOVER "WE BUY MOTOROLA LATE MODEL RADIOS"

Circle (135) on Reply Card

### Automatic Identification

Of your TX call sign avoids violations



Programmable  
with a personal  
computer

Starting at just  
\$55.50 dealer

- Send up to 50 morse code characters
- Programmable interval timer, monitor delay, code speed & tone frequency
- Two monitors & two timers to delay identification
- New CW modes - pulsed tone or carrier

#### Other Models Available

- Switch programmable identifier
- Voice identification



5504 State Rd.  
Cleveland, Ohio 44134

Made in the USA 216-351-1755 800-722-6664



- UHF
- VHF
- 800 MHz
- 3 year warranty

- \* Low Prices
- \* Fast delivery

**CSS RADIO**

Colorado Springs, CO  
1-800-305-6471

### USED 2-WAY RADIOS

Call Sid Cohen

at AIR COMM—Phoenix, AZ

(602) 275-4505 • Fax (602) 275-4555

30%-70% savings on Motorola, GE, EFJ mobiles,  
base stations, portables, pagers, repeaters—  
primarily solid state—all frequency bands. Also,  
accessory items: Motorola "Systems 90" control  
heads. PL and paging reads, channel ele-  
ments. Cash quotations made for  
purchase of above equipment.

4614 E. McDowell Rd.  
Phoenix, AZ 85008



Equipment for sale



PROCOM VHF & UHF  
FM TRANSCEIVERS

HANDHELD SYNTHESIZED PROGRAMMABLE  
5 WATTS - TEN CHANNELS

PROVIDES INSTANT COMMUNICATIONS  
WITH KEY PERSONNEL INSIDE/OUTSIDE

Ideal for use on construction sites, in  
factories, for security control, and by  
recreational supervisors.

FEATURES INCLUDE:

- Range 1 to 3 miles subject to environmental conditions.
- Weather resistant with die-cast frame, high impact case with belt clip.
- Rechargeable nickel cadmium battery pack, A.C. battery charger, flexible antenna with BNC connector. F.C.C. license application included.
- Jacks for A.C. charger, earphone, external speaker/microphone, and external antenna with BNC connector.
- Volume control/power on-off switch.
- Low/Med/High transmit power output.
- Built-in squelch control.
- Programmable CTCSS tone squelch (optional).
- Battery/transmit and busy LED indicator.
- Channel digital readout.
- Ten channel selector.
- Channel scan with channel lockout.



PROCOM M510 VHF  
Extended Range  
PROCOM MU510 UHF  
High Penetration



(800) 345-1354

14811 MYFORD ROAD • TUSTIN, CALIFORNIA 92680  
(714) 669-9890 • FAX: (714) 669-1081

See Us At IWCE Booth #4096-4098 • Circle (136) on Reply Card

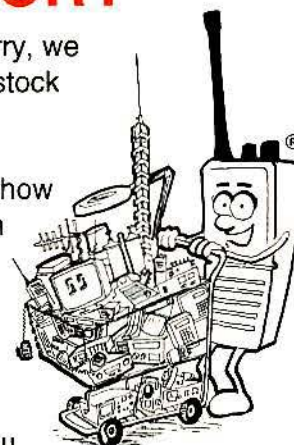
WE HAVE  
THE LARGEST  
INVENTORY

Tired of hearing "I'm sorry, we  
don't seem to have it in stock  
right now..."

At **EPCOM**, we know how  
important it is to maintain  
continuous radio  
communications  
at its best !!!

LOTS & LOTS

of everything you need !!!  
Call us... and avoid the  
"I'm sorry.. " routine!



Over 3000 different products  
to choose from more  
than 200 manufacturers !!!

**EPCOM**  
EL PASO COMMUNICATION  
SYSTEMS, INC.

1630 PAISANO DR.  
(915) 533-5119 FAX (915) 542-4701  
EL PASO, TX., 79901 U.S.A.

ASK FOR YOUR  
FREE CATALOG

U.S. Free Fax  
**1(800) 524-6564**

Circle (137) on Reply Card

COMPLETE CHANNEL  
ELEMENTS ON YOUR  
FREQUENCY FOR

\$25 - \$35!!!

ORDERS ONLY:

1-800-237-6519

INQUIRIES AND IN LA:

504-361-5525

Motrac; Micor, Mocom; Mitrek; Etc.

MT's, and GE Elements. Call for  
prices

Any desired Frequency available  
for fast delivery.

Lifetime Warranty on Crystals

Trade-in credit on your Old

Channel Elements

We Buy Used Elements

Try us first. We always have your  
frequency available.

**NKX**

1814 Hancock St.  
Gretna, LA 70053



Low Cost, Quality Connectors  
& Technician Kits!

Call CA for quick shipment of all your connector requirements.



distributed by

**Communications  
Associates Inc.**

(800) 435-9313

Order Fax (800) 284-4934

Circle (138) on Reply Card



**COMMONWEALTH**

COMMUNICATIONS INDUSTRIES, LTD.  
802 Lickinghole Road/P.O. Box 312  
Ashland, Virginia 23005

Specializing in Automated Paging Equipment

Bus: (804) 798-9128  
EARL T. Van STAVERN Sales Calls: 1-800-633-8844  
Chairman & Sales Manager FAX: (804) 798-5114

REPEATERS-STATIONS

GE MastrII Rptr, 110w, VHF .....\$1,250  
MSR2000 Rptr, 100w, VHF .....\$1,995  
Micor B93RCB, 375w, VHF .....\$1,995  
Micor C73RCB, 100w, VHF .....\$750  
Micor C73RTB, 100w, VHF .....\$395  
Cushman CE-15 Spec.Ana.-Remotes

**601-264-9760**



Equipment for sale

**Sharp COMMUNICATION**  
Distribution Center

**WHOLESALE PRICES**  
**DEPENDABLE SERVICE**

**Authorized Distributor**  
**Mobile Communications**

2-WAY SALES TO RADIO DEALERS ONLY

Order Today! **1-800-548-2484** Ship Today! FAX: 205-539-1663

**CONVENTIONAL & GE-MARC**

- Mobiles
- Portables
- Accessories

**RFI Connectors**  
**TELEWAVE Site Management**  
**SAMLEX Power Supplies**  
**WHELEN Safety Signals**



Sheila Tim Jim

GE, DISCOVER, VISA, MasterCard, Novus

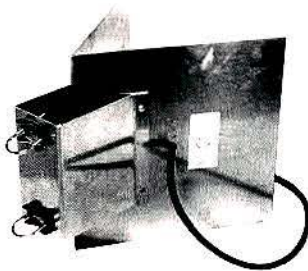
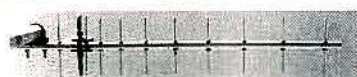
Circle (139) on Reply Card

## MARTRONICS


### WE MAKE THE BEST

For Cellular phone fringe areas long range radio shots, and frequencies from 800-1000 MHZ, try our yagi's and corner reflectors. VHF LO, and HI, UHF stack up our yagi's with the best. Custom orders, and Dealers welcome.

CALL NOW 1-805-239-1932  
4820 DEER CREEK WAY  
PASO ROBLES, CA. 93446



Circle (140) on Reply Card



**Pyramid Communications**

1198 Pacific Coast Hwy Suite D-286 Seal Beach CA 90740 (310) 430-5892

### Model VR-100 Low Power UHF Vehicular Repeater

- Motorola PAC/RT® fully compatible
- "First man out" with priority sampling
- Multiple vehicle operation: up to 256 units
- LTR® and Motorola trunking compatible
- Rugged one piece extruded aluminium case
- Compact: Only 5 1/4" W x 6" L x 1.1" H

- **Public Safety** - Wide area coverage without satellite receivers
- **EMS** - Paramedics maintain communications even inside buildings
- **Utilities** - Crossband repeat works with existing lo-band systems
- **800/900 Trunking** - Mobile coverage with a low power handheld
- **Fleets** - Eliminate pagers, cell phones and missed calls

WANTED: USED SERVICE MONITORS  
BUY • SELL • TRADE, IFR-MOTOROLA-MARCONI  
WANT: HEWLETT PACKARD SIGNAL  
GENERATORS, SPECTRUM ANALYZERS,  
TEST EQUIPMENT, etc.  
IFR 1000S-\$3600, CE50A-\$2700, IFR 1000A-\$2600  
PH: 716-661-9964; H: 716-763-9104; Fax: 716-763-0371

**FOR SALE**  
2 FUJITSU 10 UHF  
2-WAY RADIOS  
(Still in the box) BEST OFFER  
Call: 914-485-4880.  
Please leave message if no answer

## CENTRACOM II

### -Buttons and Labels-

\$6.50  
EACH

Engraved  
Buttons

All orders shipped within 48 hours.

**CENTRACOM II**  
**Reprogramming and**  
**Custom Changes**  
**NORTHEASTERN**  
**COMMUNICATIONS INC.**

Waterbury, CT 06708  
(203) 575-9008

## USED RADIOS

### at Low Prices!

- MICOR
  - MITREK
  - PORTABLES
  - MOCOM 70
  - MAXAR
  - RPTRS
  - GE
  - RCA
  - ACCESSORIES
  - TONE ELEMENTS
  - CRYSTAL ELEM.
  - BASE STATIONS
- Large Quantities • (817) 433-5452

## Now in stock:

ICOM F30LT VHF portable, Re- tail \$799. Dealer \$599. Ninety-six channels, 8 digit alpha, front panel or PC programmable. New and used ICOMS bought, sold and repaired.

**SWS Security** (410) 879-4035

USED SERVICE MONITORS CUSHMAN - MOTOROLA - WAVETEC - IFR	
Wavetek CT-2500 Monitor with Cellular Test	\$3500.00
Motorola R-2008/DITS with Cellular Test	\$6500.00
Motorola R-2001/B Service Monitor	\$4500.00
Cushman CE-50/A1/TG Spectrum/Tracking	\$4000.00
IFR 1000-A with Battery	\$2700.00
IFR 1000S with spectrum	\$3500.00

WANTED SERVICE MONITORS: IFR, Cushman, Motorola, Wavetek  
Can We Get You Best Cash Price or We Buy Loss Money  
BOUGHT - SOLD - CONSIGNMENT  
R.F. IMAGING AND COMMUNICATIONS  
408 829 2244 Pager: 510 458 6875

## Where Quality Counts



Crystals,  
Oscillators & Elements

Customer Service & Sales  
**1-800-725-1426**  
Fax **1-800-322-9426**

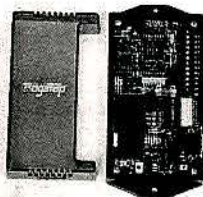
P.O. Box 26330, 10 N. Lee, Oklahoma City, OK 73126-0330



Equipment for sale

**REMOTE CONTROL ANYTHING...**

Anywhere, with the PT8-OC POCsag Remote Control Switch. Uses standard paging messages for control of up to 8 outputs.



To order call **PageTap, Inc.**  
800-735-3650 or 303-337-4811  
Fax: 303-337-3084

Circle (141) on Reply Card

Buy Direct



**GENERAL COMMUNICATIONS**

DISTRIBUTORS OF MOBILE COMMUNICATIONS EQUIPMENT

**Largest Inventory • Quality Service • Fastest Delivery & Best Prices**

5157 Anton Drive • Madison, WI 53719 • 608 271-4848 • FAX 608 274-2080

**800 356-3200**

*Because your business takes you everywhere.*



Mobile Communications



At Wholesale Prices

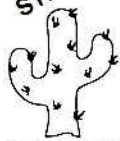
**CELLULAR & PAGER LABELS**

**LABELS THAT STICK!**

Labels for pagers, cellular phones and two-way radios with your company's logo. Warranty labels for batteries. Bar code and printing systems.

Call us for free samples.

**ADVANCE LABEL & TAG**



1725 N. McDonald St.  
McKinney, TX 75069-8230

1-800-466-5345 FAX: 214-548-2518 1-214-542-5345  
"Our years of experience are your best Insurance"

**RADIO AMERICA**

Bulletin Board Service

Buy & Sell Radios

All brands- New & Used

Hundreds of listings for Ham,

Two-way and Broadcast users.

Sign on now with your modem

**1-602-526-4000**

*No service fee to callers*

P.O. Box 30007, Flagstaff, AZ 86003-0007

Main Offices: (602) 526-6000



**COMM-NET 2000**

Automatic ON/OFF Delay Timer

- Programmable 15 minutes to 12+ hours
- Handles 30 continuous amps at 12 volts
- Easy to install
- Eliminates battery failure/replacement
- Protects your radio & cellular phone
- Family owned & operated since 1985
- Made in THE USA with 1 year warranty

Case & Hardware Included DG200 \$38 (800) 283-5158

**COMMUNICATION**

**LABELS** For Pagers, Cellular Phones, and all types of custom labels

**Anchor Graphics Inc.**

1467 LeMay #111 Tel. (214) 242-0439  
Carrollton, TX. 75007 Fax. (214) 242-0959

**BUYING ERICSSON-GE EQUIPMENT CALL OR FAX FOR QUOTE**

1/4 KW GE sta. blower motor, new	\$85
Mastr II base sta wire harness	\$25
MPD VHF 5W w/scan	\$285
MPX/MPR new parts, large qty.	CALL
MPI 8-Unit multicharger, checked	\$40
Delta-S 450-470 less acc. 100W	\$295
Delta-S 450-470 40W S-990 acc	\$299
Delta-S 450-470 40W no acc.	\$150
Delta-S 42-50 less acc. 110W	\$135
MLS 150-174	\$285
MLS-I Controls 16 ch. non scan	\$60
Phoenix-SX VHF 16 ch. scan	\$225
MVS NPH20 VHF 16 CH. SCAN	\$325
Exec. cables new	\$30
PLS/MPD/MPA Multi-chngr. new	\$100
PLS/MPD/MPA/TPX Rapid desk new	\$72
MASTR II 150-174 110W from	\$115
MASTR II 42-50 110W w/acc.	\$165
MASTR II Accessories, complete	\$50
MASTR II Multi-channel cables	\$20
MASTR II C-500 w/scan or PA	\$25
S-825 scan or systems w/warr.	\$225
S-990 128 ch head w/warranty	\$125
S-950 128 ch head w/warranty	\$75
MPS/MPR/MPX/MPI/MPD Chargers	CALL

**NEW LONDON TECHNOLOGY**

231 Old Timberlake Road  
Forest, Virginia 24551  
TEL 804-525-0068 FAX 804-525-0078

**UAntenna**

Low Profile • Low Band  
Antenna for Radio  
Communication



- FEATURES:**
- Up to 95% Height reduction
  - Easy Installation
  - High Performance • Low Cost

Model CR109A  
**THE ULTIMATE LOW BAND**

**COM-RAD INDUSTRIES**

PO Box 88, Wilson, NY 14172

For Immediate Fax Info & Technical Assistance,  
Tel: 716/751-9945 • Fax: 716/751-9879

**CHANNEL ELEMENTS**

**YOUR FREQ. - \$20.00**

with trade-in/3 working days

**CRYSTALS \$9.95**

MAXON, TEKK, UNIDEN/7 working days

**CEH/Kirby Enterprises**

4120 Kirby Rd. Cincinnati, OH 45223

**1-800-237-9654**

FAX: 513/542-8870

**FOR SALE**

- 1 BBL System 6x Paging Terminal (several spares)
  - 1 BBL System 4x Paging Terminal (several spares)
  - 1 Dictaphone 10 channel DUAL DECK Logging Recorder (w/tapes)
  - 2 StarTel System 2050 Telephone Switches (Answer Service)
  - 1 Ademco 685 Central Station Alarm Receiver (w/line cards)
  - 130 Motorola Metrcx 5/6 Tone Pagers
  - SEVERAL miscellaneous support items!!!
- Will sell as lot or separate. Contact: Larry (214) 470-0411



## Classified

### Equipment wanted

**Equipment Wanted**  
Motorola, Johnson, GE,  
EFJ, Uniden, Standard  
**Buy-Comm-Co.**  
**1-800-347-4121**  
**FAX (602) 585-6900**

### Rentals

#### **MOTOROLA RADIO RENTALS**

- MT1000, HT600, P200
- Intrinsically Safe
- All Types Headphones
- Mobiles & Portapacks
- Repeaters & Crossband Sets
- Dealer Inquiries Invited

**1-800-283-COMM**  
**EVENT RENTAL COMM., INC.**

**MOTOROLA**  
**Radius**  
Rentals

- GP300, P200
- Mobiles, Repeaters
- Intrinsically Safe
- Dealers Welcome

**1-800-822-MOSS** **MOSS COMMUNICATIONS**

Motorola Radio Rentals  
**1-800-548-2151**  
**Brower Two Way Radio**

### Business opportunity

**SOUTH FLORIDA**  
**152 MHz RCC CHANNEL**  
Newly licensed 2 way/paging facility.  
Asking \$150K.  
Call John at:  
**800-332-0377**

### Tower space

#### **45 California Antenna Sites... ...and Growing**

Call for the latest listing  
of premier California sites



#### **Newest Site: Mission Valley, San Diego**



DIABLO COMMUNICATIONS, INC.

**Northern California - Pt. Richmond**  
(510) 236-3700 Fax (510) 236-3799  
**Southern California - Burbank**  
(818) 842-5000 Fax (818) 842-5335

Circle (142) on Reply Card

#### **AAT Communications Corporation**



With over 900 communications sites throughout the eastern US, AAT controls the heights. And with over 40 years of specialization in telecommunications site managing, marketing, constructing, leasing and engineering, AAT has the experience to provide tip-top performance at a down-to-earth price.

So why climb alone? AAT will put you above the competition and on top of the world.

New Sites in GA, AL, IN

**PCS & Receive-only Sites Available**

#### **AAT Communications Corporation**

**PARKSIDE CORPORATE CENTER**  
292 Fernwood Avenue, Edison, N.J. 08837  
For more information contact: T.E. Smith  
**908-417-3993 • Fax: 908-417-4825**

#### **MicroNet inc.**

##### **Site Management**

**Over 100 sites in inventory**  
California, DC, Maryland,  
Massachusetts, New Jersey, New  
York, Pennsylvania and Texas

##### **Site Development and Acquisition**

**MicroNet**  
**Site Management**  
2370 York Road, Bldg. B  
Jamison, PA 18929

(215) 491-7400  
fax (215) 491-0260

Contact Jim Innes

#### **40+ choice antenna sites in California.**

- Stand-by Power / Air Cond.
- Continuous Monitoring
- High-Security Access System
- Land available for develop-  
ing your own site at  
Oat Mountain, Chatsworth



**Meridian  
Communications**

Great sites, great service, since 1956.



Call Rich or Jack Reichler at  
**(800) 400-SITE**

#### **FOR LEASE**

**OVER 5,000 TOWERFUL™  
COMMUNICATION SITES**  
for expanding coverage

- Cost Efficient Performance • Competitive Prices
- Nationwide Sites • Prompt License Filing
- PAGING • PCS • SMR/ESMR • MOBILE DATA • BROADCAST

**615-775-8079**

P.O. BOX 23387 • CHATTANOOGA, TN 37422

"One Call and Your  
Signal is On"™

**SIGNAL ONE**



**RF RADIATION MEASUREMENTS**  
ANSI/IEEE - 1992

**TROTT**  
COMMUNICATIONS GROUP  
1425 GREENWAY DRIVE, SUITE 350  
IRVING, TEXAS 75038  
214/580-1911 • FAX: 214/580-0641



**Tower space**

**NEED TENANTS??**

Advertise your sites in the  
**NATIONAL COMMUNICATIONS  
SITE DIRECTORY**

Dedicated to advertising antenna sites for lease

**NEED SITES?**

The NCSD contains thousands of prime antenna sites, all with space for lease just \$15 per year. For information call: Tel: (908) 462-5964 Fax: (908) 308-4633

**PRIME NORTHERN  
NEVADA SITES**

Our newest, Pond Peak, at 8035' AMSL, 2635' AAT, Emergency Power, Air Conditioning, Overlooking Reno, Fallon and the I-80 corridor,

**702-825-2626**

**GREAT BASIN COMMUNICATIONS**



STAN STANN

TEL: (708) 823-7713

**CHICAGO TOWER  
LEASING CORP.**

**COMMUNICATIONS  
TOWER & ANTENNA  
SITES FOR THE  
METROPOLITAN CHICAGO  
AREA**

P.O. Box 31160  
CHICAGO, IL 60631

**WESTERN WASHINGTON**

Commercial power with generator backup.  
Good security. Year around access.

Five Sites

**GOLDSPAR COMMUNICATIONS**

Alan Robinson

206-475-9430 Fax 206-475-9410

**ARIZONA'S PREMIER  
TOWER FACILITIES**

Contact Rick or Charlie Bonifasi  
**ANTENNA SITES, INC.**

**602-998-7222**

**TOWER AND EQUIPMENT SPACE**

On St. Thomas with a panoramic view ow US Virgin Islands. A/C, Standby power, telco facilities and engineer resident on site.

**AVALON COMMUNICATIONS CORP.**

809-776-8282 fax: 809-774-8204

Contact Scott Thompson to place a

**MRT**

classified ad

1-800-771-3351

(913) 967-1923

Fax: (913) 967-1735

# We've got you covered.

For superior antenna site coverage along with the Quality and Customer Service you expect from an industry leader - choose Motorola. Our nationwide network of antenna sites offers you space on thousands of premier antenna sites across the country. Contact Motorola Network Services Division today for your local and national site needs or to find out more about our site planning and management services.

U.S. Network Services Division,  
Antenna Site Information  
708-538-6333



© Motorola, 1991. ® and Motorola are trademarks of Motorola, Inc.

Circle (143) on Reply Card

Use  
Color  
To Make  
Your  
Classified  
Ad  
**JUMP**  
Off  
The  
Page!



**THE BEST SITES IN**  
Houston, Chicago, Atlanta, Denver,  
Nashville, Louisville, New Orleans,  
Ft. Worth, San Antonio, & Corpus Christi  
11111 Katy Freeway, Suite 360  
Houston, Texas 77079  
**(800) 966-8885 Fax (713) 984-0066**

**Tower services**

**Xcel**  
CONTROLS, INC.  
1600 West 6th Street  
Mishawaka, IN 46544

PHONE 1-219-259-7804  
FAX 1-219-259-5769  
SUPPORT 1-800-288-7362  
CompuServe® 72703,1415

**CONTROL POWER SYSTEMS FOR TOWER LIGHTS**

ECN Series: Lower cost controllers  
for towers up to 349 ft.

CPS Series: Advanced controllers for all towers

RCP Series: Remote Monitoring Systems



Circle (144) on Reply Card



**Tower services**



# Tower Watch

## Tower Monitoring Systems

- FAA Reporting and Logging (to meet FCC & FAA requirements)
- Lighting & Security Alarm Equipment
- Central Station Monitoring

1-800-475-1780

Dealer Inquiries Welcome



## SABRE COMMUNICATIONS CORPORATION

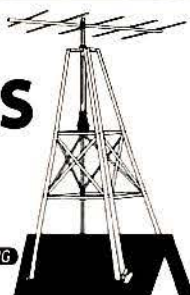
Designs, Manufactures, Installs  
Guyed and Self Supporting  
TOWERS  
Worldwide For  
CELLULAR, MICROWAVE, BROADCAST,  
CATV AND SPECIAL APPLICATIONS

3400 HWY 75 NORTH  
P.O. BOX 536  
SIOUX CITY, IA 51102

PHONE (712) 258-6690  
1-800-369-6690  
FAX (712) 258-8250

Circle (156) on Reply Card

# ROOF TOWERS



Model	Ht.	Base	Wind Ld	UPS PPD
RT-224	4.5'	24"	6 sq. ft.	144.95
RT-832	8'	32"	8 sq. ft.	205.45
RT-936	9'	36"	18 sq. ft.	356.00
RT-1832	17.5'	32"	12 sq. ft.	493.25

816-882-2734

## Services



DUPLXTUNE  
303 FRIES RD  
TONAWANDA, NY 14150  
716-834-2787

REPAIR & RETUNING  
OF  
DUPLEXERS  
Filter Systems  
Rx Multicouplers

## Repair services

### MOTOROLA PORTABLE & PAGER REPAIR

- PAGERS \$ 10 + PARTS
- PORTABLES \$ 29 + PARTS
- SYNTH. PORTABLES \$ 49 + PARTS
- QUICK TURN AROUND • FREE RETURN SHIPPING

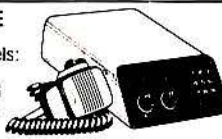
TEL: 305-983-0125 FAX: 305-983-0324  
ARCOM, INC. 8362 Pines Blvd Suite #395  
Pembroke Pines, FL 33024

### \$25.00 FLAT RATE

Plus Parts & Shipping

On the following models:

XLH-250 RH-250  
RH-256 WH-2516  
WH-2510 RFH-252  
UC-102 UC-202  
TRH-202



### REGENCY/WILSON

\*OTHER MODELS - \$30/HR Plus Parts & Shipping

MULTICOM

2608 N. Moore Ave. • FAST TURNAROUND  
Moore, OK 73160-3316 • FACTORY TRAINED  
405-799-7356 800-680-7356 • VISA • MASTERCARD • COD



### MOTOROLA

Authorized Service

- Authorized warranty Service
- Quick Turn Around
- Flat Rate Repair Available
- Free Estimates
- Quantity Discounts

COMMUNICATIONS SOLUTIONS  
(719) 547-3683

You Can Reach Over  
10,000  
INDUSTRY  
PROFESSIONALS  
For a Low Price

**ADVERTISE IN  
CMI CLASSIFIEDS!**

Contact  
Scott Thompson  
Classified Advertising  
800-771-3351  
(913) 967-1923  
Fax: (913) 967-1735

**CELLULAR  
& MOBILE  
International**

### STUDY LAND MOBILE COMMUNICATIONS AT HOME!

38 lessons written exclusively for Mobile  
Communications Servicing. \$375.00

Call or write Mobile Training Institute  
for free information:



P.O. Box 8278  
Lumberton, TX 77711-0278  
(409) 755-7838

small costs.  
**BIG RESULTS!**

MRT Classified Advertising  
Contact Scott Thompson

(913) 967-1923

### LOW FLAT RATES - FAST SERVICE TURNAROUND - SOFTWARE

1-800-354-3405



**THERE ARE  
ALL TYPES OF  
COMMUNICATIONS**

**LAZER BEEPERS, INC.**

Would like to help bring you into the  
21<sup>st</sup> Century with their Highly Trained  
Technicians & One-Stop Service  
Clinic. Call us today for all your  
Beeper needs.



**LAZER BEEPERS, INC.**

**SATISFACTION GUARANTEED - BUY & SELL USED BEEPERS**

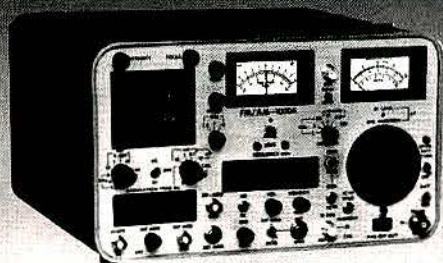
ALL BRANDS - RECRYSTALLING

Circle (146) on Reply Card



**Repair services**

**SAVE MONEY ON 1000A/S REPAIRS . . .**



Specializing in Service Monitors since 1973

**We buy and sell  
used monitors!**

Phone (303) 962-9998

FAX (303) 962-3991



**COMMUNICATION  
INSTRUMENTS™**

1714 SW 23rd Street, Loveland, CO 80537

**SQUELCH**

COMMUNICATIONS  
REPAIR of MOTOROLA PORTABLES

\$35.00 FLAT RATE

PLUS PARTS & SHIPPING

- Quick turn around
- VHF, UHF, TRUNKED

**CALL 602-240-0479**

**Just Think...**

If this had been your ad, you'd  
have a prospect right now!

**Call Scott Thompson**

**1-800-771-3351**

**(913) 967-1923**

**CUSHMAN**

**NEW PRODUCT**

**Model K-30**

**10 MHz Frequency  
Selective Levelmeter**

Model 7125 Service Monitor



**1GHZ Gen & Rec  
Spectrum Monitor**

**New Features**

- Lever Switch Freq Entry
- Decode DTMF/DCS/CTCSS

MANUFACTURED BY:

**KNS ELECTRONICS INC.**

2146 BERING DRIVE

SAN JOSE, CA 95131

PHONE (408) 432-8100

FAX (408) 432-8359

Circle (147) on Reply Card

**LOUDOUN COMMUNICATIONS, INC.**

*Communications Systems*  
**REPAIR DEPOT**

Microprocessor based Mobiles,  
portables, controlheads.

GE Warranty Processing

Fast turn-around



**585 Factory Shoals Road  
Austell, GA 30001**

**404/948-9566**

Be  
Courteous...

Tell the  
advertisers in  
**MRT**  
where you  
saw their ads.

**NS ELECTRONICS SERVICE INC.**

COMMUNICATIONS MONITORS SALES & SERVICE

N.I.S.T. TRACEABLE CALIBRATION

CUSHMAN IFR

DISTRIBUTOR FOR

SALES NEW-USED

OPTO ELECTRONICS, INC.

3610 Dekalb Technology Parkway  
Suite 110/111

Atlanta, Georgia 30340

(404) 451-3264

Fax: (404) 458-8785

**CALL**

AUTHORIZED  
CUSHMAN SERVICE



**Triton  
Electronics, Inc.**

**SERVICE MONITOR**

**REPAIR & CALIBRATION**

Exclusive monitor repair since 1973

**NIST TRACEABLE**

Cushman, IFR, Motorola, Marconi

4300 Lincoln Ave., Unit O

Rolling Meadows, IL 60008

(708) 934-6426 Fax (708) 934-7195

**Mobile Radio  
Technology™**

Call **Scott Thompson** today to reserve  
space for your classified ad!

**Ph: 800-771-3351 Fax: (913) 967-1735**

**Invest  
Your Advertising  
Dollars Where  
Your Prospects  
Invest  
Their Time!**



# How to enter the wireless world with profitability assured.

Come for free!

**WirelessWorld<sup>TM</sup> Expo '95**

**November 7-9, 1995  
Moscone Center  
San Francisco, California**

The fastest-growing event in wireless communications is coming to San Francisco this November. And you can be there absolutely FREE!

Explore hundreds of exhibits featuring the latest products and services available to help you gear up for the exploding wireless communications industry.

Wireless system operators, including PCS licensees, retailers, dealers, resellers, agents, large volume users, manufacturers—anyone whose future is affected by the new age of wireless data and voice communications—will find hundreds of profitable new ideas on the WirelessWorld Expo floor.

**Also, experience the industry's most comprehensive conference.**

For the most complete WirelessWorld experience, the conference program could be the smartest \$495 you'll invest this year.

From the top experts in wireless, you'll find surprising solutions to the challenges you're facing today—and will face tomorrow. *Where is the cellular industry headed? What challenges do PCS licensees face? Will cellular and the new wireless carriers be able to co-exist and still make money? How much money can I make?*

This is your opportunity to find some hard answers. In a conference program that nine out of 10 participants have said they'd either attend again or recommend to others.

**Return this form now for your FREE Expo Pass, plus complete information on the conference, hotels, special events and more. Or for more information, call TOLL FREE at 1-800-601-3858 or 913-967-1969.**

## ATTENTION VENDORS:

Prime exhibit space is filling up fast!  
Contact Ms. Billi Famiglietti  
at E.J. Krause & Associates,  
301-986-7800

<b>ADMIT ONE</b>	<b>WirelessWorld Expo '95 • November 7-9 Moscone Center • San Francisco, CA</b>		<b>EXHIBITS</b>	
	First Name _____ Last Name _____			
	Title _____			
	Company _____			
	Address _____ State _____ Zip _____			
	City _____ Fax _____			
	Telephone _____			
	<b>PRIMARY BUSINESS (Check One)</b> <input type="checkbox"/> Wireless System Operator <input type="checkbox"/> Cellular <input type="checkbox"/> PCS <input type="checkbox"/> Paging <input type="checkbox"/> SMR/ESMR <input type="checkbox"/> Radio Common Carrier <input type="checkbox"/> Other			<input type="checkbox"/> Dealer/Retailer <input type="checkbox"/> Sales Agent <input type="checkbox"/> Manuf./Manuf. Rep. <input type="checkbox"/> Consultant/Analyst <input type="checkbox"/> End-User <input type="checkbox"/> Other
	<b>YOUR TITLE (Check One)</b> <input type="checkbox"/> Owner/President/CEO/Partner <input type="checkbox"/> VP/Manager/Director <input type="checkbox"/> Engineer/Service Manager/Supervisor/Technician <input type="checkbox"/> Purchasing Director/Manager <input type="checkbox"/> Marketing/Sales Manager <input type="checkbox"/> MIS/DPLAN Manager <input type="checkbox"/> Other			<b>YOUR PURCHASING ROLE (Check One)</b> <input type="checkbox"/> Make Final Decision <input type="checkbox"/> Recommend <input type="checkbox"/> No Purchasing Role
	<b>FAX TO:</b> <b>602-443-8767</b>			

WirelessWorld Conference & Expo is organized by Intertec Publishing Corp. and E.J. Krause & Associates

**WirelessWorld<sup>TM</sup> Expo '95**

Conference & Exhibition

Sponsored by:

**Cellular<sup>®</sup>**

**WIRELESS<sup>™</sup>**

**Telephony<sup>™</sup>**

**CELLULAR  
& MOBILE<sup>™</sup>**

**Mobile Radio<sup>™</sup>  
Technology**

Circle (148) on Reply Card



**Computer software**

**Service - Sales - SMR Billing  
Pager Billing - Accounting**

Computer Resources, Inc. has the solution for all types of two-way radio billing and management problems. Systems are available on DOS, Novell, Lantastic and UNIX. The CRI system is modular and completely integrated. We can provide complete solutions including software, hardware, and training.

205-987-1523 / 205-987-1709 FAX

Circle (149) on Reply Card

**PAGER & CELLULAR  
BILLING SOFTWARE  
800-466-6261  
CALL FOR DEMO  
PAGE-1 SOFTWARE**

Circle (150) on Reply Card

**Identify and prevent RF  
communications site interference**

- Transmitter Noise/Receiver Desense Analysis  
- Intermodulation Signal Level Analysis  
- Eliminates Manual look-up of filter curves

"See our display ad on page 87"

**COMSITEPLUS™**

For a brochure, call 1-800-845-0408

See Us At IWCE Booth #7108

**✓ MICROPATH® Delivers  
USGS 30 Meter DEMs**

**FAST!** On-Line & On-Time  
Over 31,000 1:24,000 DEMs In-Stock

Why pay more elsewhere?  
Same pricing as USGS!

Waiting 2-4 weeks for delivery?  
BBS download on demand and  
overnight delivery available

DEMs available on:  
3½" DOS Disk, Custom CD-ROM,  
8mm / 4mm Tape, 9-Track Tape

Quickly identify your map data needs!  
You can graphically select the correct  
DEM / DLG / Quadmap easily with

**Map Wizard for Windows**

• Call for **FREE** demo disk!

Or download WIZARDMP.EXE from our BBS

**MICROPATH®**

Tel (303) 526-5454 / Fax (303) 526-2662  
BBS (303) 526-1023

Internet: 76341.2442@compuserve.com

**Radio Propagation Software for PC's / WINDOWS**

- LMR Predicted Area Coverage - Multi-Site Composite Coverage Maps
- No Radial Generation Required - Real Time Propagation Study / Profiles
- DXF / HPGL Output - Direct Interface with AutoCAD, TurboCAD, etc.
- Multiple Propagation Models - Okumura, Field Strength, Shadow Maps
- VHF / UHF / Microwave Point-to-Point Path Profiles and Link Analysis
- 3 Second Digital Elevation Data on CD-ROM and Floppy Disk



**Rocky Mountain Communications, Inc.**

2023 Montane Drive East • Golden, Colorado 80401-9123

Tel: (303) 526-5454 • Fax: 526-2662 • BBS: 526-2723

**NORTON ENGINEERING**

**MICROWAVE SYSTEMS**

- On-Screen Path Profile Design
- Diffraction Loss Calculations
- Reflected Signal Analysis
- Route and System Diagrams
- Map Crossings Graphic with Dimensions
- Performance Predictions - Analog & Digital
- High Resolution Graphic Printing - Printers & Plotters - Black/White & Color
- Reads 3-second Terrain Data

10002 McDuff Court  
Vienna, Va 22181  
Phone: +1 703 938-5745  
Fax: +1 703 938-9168

**RADIO COVERAGE**

- Coverage Diagrams - Single Signal Level - Black & White
- Coverage Diagrams - Multiple Signal Level - Multiple Color
- 360 Radials - 12.5, 25 and 50 Mile Radius
- User Defined Antenna Pattern
- Antenna Radiation Diagram Plot
- Relief Maps - Multiple Colors
- Reads 3 Second Terrain Data

**FREE BROCHURE  
AND  
DEMO DISK**

Circle (151) on Reply Card

**Applied Spectrum Research**

Frequency Management  
Consultation  
Software Development and Planning

2975 Valmont Rd, Suite 100  
Boulder, CO 80301 USA  
(01)303 444 4871  
Fax: 303 444 4872

**John P. Murray**

**TCS**

**CONSULTING SERVICES**

- Microwave Systems
- 2-Way Radio Systems
- Telemetry / SCADA Systems
- Path Survey & Analysis
- Specifications & Licensing

**U.S.G.S. MAP DATA BASE; 30 SECOND & 3 ARC SECOND DATA BASES**

**ENGINEERING AID SOFTWARE**

- Microwave Calculations
- Path Profiles (Graphics)
- Mobile Coverage
- Multi-Point Calculations
- HAAT Calculations

**CONTACT: JERRY SIMMONS**

P.O. Box 884, Montgomery, TX 77356 • (409) 588-3200 • FAX (409) 588-4434



Computer software

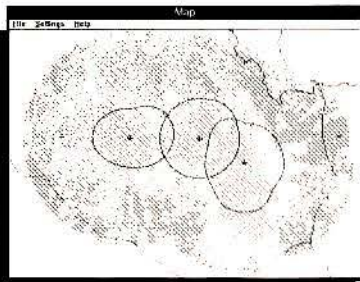
# RFCAD™

FOR WINDOWS IS HERE!

CDS has been the leader in high quality propagation analysis software and services for over twelve years - RFCAD™ is the keystone in our line of RF-Engineering Tools™.

For the most efficient, effective, and accurate Multiple Site Coverage Analysis PC software package in the industry, there is only one choice: RFCAD™.

In addition to the PC software package, CDS also offers UNIX based propagation packages, Online Remote Access Propagation Services, and an array of additional services and products. Please contact us today to request the latest catalog of services.



- Microsoft Windows Application
- Received Power Analysis
- Multiple Site Composite Coverage (any number of sites)
- Land Use and Land Cover Data Base Available
- Statistical Analysis of Model Performance Available
- Multiple, Propagation Models to Choose From (Longley-Rice, Bibby-C, CRC)
- 3 Second Terrain Data Available on Single CD-ROM
- For U.S., Canada, and Mexico
- Field Data Integration
- Demonstration Disks Available



Communications  
Data Services, Inc.

6105-E Arlington Blvd.  
Falls Church, VA 22044  
(703) 534-0034 - (800) 441-0034

Circle (152) on Reply Card

## Find Solutions

To Your RF Coverage  
and Site Management  
Problems ...  
On your own PC!

Whether microwave, multi-site, or field strength coverages, our Terrain Analysis Package (TAP)™ helps you understand everything from dBu to 3-D plots and site management software. Give us a call and we'll tell you how. Do "what if" studies and solution analysis in-house! Call for free brochure & demo disk.



**SOFTWRIGHT, LLC**  
1010 So. JOLIET ST., SUITE 204  
AURORA, CO 80012-3150 USA  
TEL. (303) 344-5486  
TELE TAP (BBS); (303) 344-5378 (9600, N,8,1)  
FAX: (303) 344-2811

Circle (153) on Reply Card

Contact  
Scott  
Thompson  
to place  
your  
classified ad.

800-771-3351  
(913) 967-1923  
Fax: 967-1923

## Reprints

"Great article!  
Can we get copies for  
our clients and sales  
force?"

Whether it's an article, ad, or an interesting column, take advantage of this unique opportunity to promote your business and products through reprints - available from this magazine. Reprints are great promotional pieces and make excellent marketing tools ... all at a minimal cost.

Available in full-color or black & white, reprints can be obtained from any issue.

For a free price quote, contact Chris Lotesto, toll-free at 800-458-0479 or 312-435-2357.

Circle (154) on Reply Card



**Software For**  
401 FCC Licensing and Price Quotes 574  
SLATTERY SOFTWARE  
(813) 697-8008

## SPATCH

Alphanumeric Paging Software  
for UNIX and PC Networks  
(404) 495-0718

### CUSTOM RF SOFTWARE TOOLS

Coverage	Digital
• Digital/Analog	• Throughput
• Reliability	• Response time
• 2D contours	• Fast Color Printer plots
• 3D terrain grid	• Map Features

Simulcast Interference Minimization & Others  
CMC CONSULTING (214) 612-8880

## INCREASE your sales in 1995

Showcase your product or service in the cellular industry's largest classified advertising marketplace.

To reach more than  
20,000\* prospects in  
our next issue, contact:

Scott Thompson  
Classified Advertising  
Phone: 800-771-3351  
Fax: (913) 967-1735

**Cellular**  
BUSINESS

\*June 1994 Publisher's BPA Statement

Use Color!



# OPTIMA II BILLING SOFTWARE

## For the Information Super-Highway

**Cellular • CDPD • SMR • ESMR • E-Mail • R-Mail • PCP • Packet • Reseller • Wireline • Rental Billing • Collections • Accounts Receivable • Customer Care • Trouble Ticketing, in a Single Package. Features include Switch Control • Real-Time Data Collection and Rating • On-Demand Billing • 60 Million Systems • 2 Million Networks • Over 4,000 Table-Driven Rate Codes, Rate Groups, Tiered Commission Plans, Pro-Rate Codes, Toll Tables, Special Tolls, Tax Codes and Terms Codes per System • 28 Billing Cycles per Month • 5 Usage-Based Pricing Tiers, 6 Unit Count-Based Pricing Tiers • Automatic Scheduled Rate Changes • 6 Time Zones and Free-Minute Periods per Rate Code • Individual Block Time / Kb per Rate Code • V & H Table Import • Rate Code-Specific Switch Options and Billing Cycles • Calling Party Pays • Roamer & Third Party Billing • CIBER In-Collect / Out-Collect Processing • System and Agent-Specific Number Inventories • Rental Inventories • Rental Depreciation • Automatic Dunning • Past-Due Unit Call and Notification • Credit Card, Direct Debit and Stop-Limit / Metered Billing • Automatic Future-Date Activations, Deactivations and Rate Changes • Lock-Box Interface • Bills in any Language or Currency • Multi-Currency Reporting and Accounts Receivable Processing • Inventory • Serialized Inventory • Duplex Printing • US / International Paper Sizes • Auto-Sorter & Zip + 4 / 5 Post Net Coding • Optional Bar-Coding, POS, Sales / Service Management, Telemarketing, Quote Management, Purchasing, Accounts Payable, and General Ledger • Turn-Key Systems • Toll-Free Support • Special Reseller / RSA Lease Rates • World-Wide Training / Installation, and Much More!**

... and those who charge others for its use !



*ACCESS RATING AND INFORMATION SYSTEMS, INC.*

**10681 Foothill • Cucamonga, CA 91730 • (800) 874-7749 • (909) 980-1034 • FAX (909) 944-3995**

Circle (155) on Reply Card



# A d index/hot line

Company	Page Number	Fast Fact Number	Advertiser Hotline	Company	Page Number	Fast Fact Number	Advertiser Hotline
Advanced Videotech Corp	90	95	800-233-0013	Midian Electronics, Inc.	32F	30	602-884-7981
Alexander Batteries	30	26	800-526-ALEX	Mobile Mark, Inc.	26	23	800-648-2800
Allen Telecom Group	IFC	1	800-676-5342	Mobile Radio Technology			
Andrew Corporation	19	16	708-349-3300	Reprints	114	154	800-458-0479
The Antenna Farm	101	126	800-255-6222	Modular Communication Systems	21	18	818-764-1333
APCO National Conference	64	62	800-949-2726	Motorola Advanced Messaging	64A-64L	63	800-520-PAGE
Aris	115	155	800-874-7749	Motorola C&E	109	143	708-538-6333
Astron Corporation	31	27	714-458-7277	Motorola Test Equipment	5	6	800-235-9590
Automation & Electronics Engr.	102	127	800-527-4596	Mounting Solutions Inc.	54	51	715-355-5667
Avcom of Virginia	50	47	804-794-2500	MX-COM, Inc.	7	7	800-638-5577
Avtec Inc.	20	17	803-892-2181	NATCOM Inc.	63.99	61,115	800-844-8267
Bird Electronic Corp.	73	71	216-248-1200	New Mar	92	100	800-854-3906
Bomar	56	53	800-526-3935	Nexus Business Comms Ltd.	77	74	
Bramco, Inc.	102	129	513-773-6255	Norcomm Corp.	78	75	916-477-8400
Cadex Electronics Inc.	89	94	604-451-7900	Norton Engineering	113	151	703-938-5745
Cartwright Communications	85	85	800-543-8614	Omnicron Electronics	81	80	203-928-0377
CELWAVE	34-35	31	800-321-4700	Orbacom Systems Inc.	57	54	609-829-4455
Centurion International Inc.	9	8	800-228-4563	PageTek Inc.	92	97	919-876-8294
C.E.T., Inc.	79	76	904-426-0014	Pana-Pacific	71	68	408-374-7900
Chargeguard Corp.	102	128	800-458-3410	Pekaar Communication, Inc.	100	121	201-772-0704
David Clark Co., Inc.	23	20	508-751-5800	Photocomm, Inc.	85	86	800-223-9580
Communications Associates, Inc.	105	138	800-435-9313	Pipo Communications	83	82	916-644-5444
Communications Data Services	114	152	800-441-0034	Pirod, Inc.	67	64	219-936-4221
Communications Specialists	BC	3	800-854-0547	Polaris Industries	103	131	800-752-3571
Connect Systems, Inc.	13,72	10,69	800-545-1349	Polyphaser Corporation	24	21	800-325-7170
Control Signal Corp.	16	12	303-989-8000	Pyramid Communications	106		310-430-5892
CPI Communications Inc.	86	88	214-437-5320	Radio Express, Inc.	104	135	703-830-2911
Crystronics, Inc.	97	111	305-566-6949	Radiomate	93	101	800-346-6442
Datacom Inc.	50	46	217-222-0160	Radio Midwest	103	132	800-521-2468
Diablo Communications, Inc.	108	142	510-236-3700	Radio Wholesale	104	134	800-53-RADIO
Doppler Systems, Inc.	87	90	602-488-9755	RAM Communications Consult.	97	110	908-636-6970
Douglas Integrated Software	87	89	904-656-8673	Ramsey Electronics	99	117	716-924-4560
DPR Inc.	99	118	800-460-1377	RCW Distributing	101	125	800-726-9015
Duracomm	97	112	913-746-8300	RELM Communications	IBC	2	800-648-0947
EAGLE	18	93	602-204-2597	Ritron Inc.	59	56	800-USA-1USA
Eagle Telecom Intl.	27	14	713-280-0488	Rocky Mountain Comms Inc.	113		303-526-5454
E F Johnson	37	33	899-328-3911	Santa Fe Distributing	82	81	913-492-8288
Electrocom	88,93	92,102	310-946-9493	Sentry Manuf. Co.	99	116	800-252-6780
El Paso Communications	105	137	915-533-5119	Serviceware Corporation	62	60	613-521-7391
EMR Corp.	72	70	602-581-2875	Sharp Communication	106	139	800-548-2484
Ericsson	39	35	800-GE1-2345	Shure Brothers, Inc.	47	42	800-255-HURE
E Trunk Systems, Inc.	100	122	914-245-1128	SMC Electro-Mount	86	87	800-527-1079
Everon America Inc.	58	55	800-603-3766	Softwright	114	153	303-344-5486
Fanon Courier	105	136	800-345-1354	Solar Electric Specialties	36	32	800-344-2003
Fourth Dimension	98	113	516-467-1220	Sonic Communications Inc.	12	9	800-688-1944
Gamber Johnson	42	38	715-344-3482	Spectrum Communications Corp.	88	91	610-631-1710
Gencron Engineering Inc.	48	44	800-556-8866	Sti-Co Industries Inc.	40	36	716-662-2680
Grayson Electronics	25	22	800-800-7465	Tait Electronics USA			
Harger Lightning Protection	81	79	708-362-4848	Inc.	Belly Band		713-984-8684
Henry Radio	54	50	800-877-7979	Talley Communications	62	59	800-949-7099
Hewlett Packard	43	39	509-921-4001	Tessco	45		800-472-7373
Hustler, Inc.	51	48	800-949-9490	TGA Systems, Inc.	22	19	404-441-2100
Hutton Communications	38	34	800-442-3811	Times Microwave Systems	68	65	203-949-8400
Hy-Q International	101	124	606-283-5000	Towerwatch	110	156	800-475-1780
IFR Systems, Inc.	53	49	316-522-4981	TPL Communications Inc.	60	57	213-256-3000
JBRO Batteries, Inc.	41	37	800-323-3779	Transcrypt International, Ltd.	3	5	800-228-0226
Jeep/Eagle	94			Trilogy Communications, Inc.	15	11	601-932-4461
JFW Industries Inc.	76	73	317-887-1340	Tripp Lite	46	41	312-329-1407
Kaval Electronics Inc.	70	67	905-940-1400	Valmont Industries, Inc.	44	40	402-359-2201
Kenwood U.S.A. Corporation	69	66	310-639-4200	Vega, A Mark IV Company	1	4	818-442-0782
KNS Electronics Inc.	111	147	408-432-8100	Versatel Communications	100	120	800-456-5548
Larsen Electronics	49	45	800-426-1656	Vocom/RF Corporation	83	83	800-USA-MADE
Lazer Beepers, Inc.	110	146	800-354-3405	Wacom Products, Inc.	16	13	817-848-4435
Lighthouse Engineering	101	123	800-LH-AMP-4U	WAVETEK	17	14	800-392-8100
Marketronics Corp.	92	99	800-845-1230	West Coast Radio	104	133	310-268-2464
Martronics	106	140	805-239-1932	Wetec Electronics	103	130	901-286-6275
Maxon America, Inc.	29	25	816-891-6320	Wilmore Electronics Company	80	77	919-732-9351
Maxrad, Inc.	91	98	800-323-9122	WirelessWorld Expo '95	112	148	800-601-3858
McManus Communications	98	114	501-763-6250	W&W Associates	32A	28	800-221-9732
Mechem Electronics	100	119	703-891-0569	Xcel Controls Inc.	109	144	219-259-7804
Meridian Communications	55	52	818-222-5655	Zetron, Inc.	32E,75,84	29,72,84	206-820-6363
Metrolux Mobile Data	90	96	305-739-0850	Z Technology	80	78	503-591-5051
Microlect	61	58	503-363-9267				
Microwave Filter Company Inc.	48	43	315-437-3953				



# Good Things & Small Packages



Yes, it's true! Good things **DO** come in small packages...especially at RELM Communications. RELM's new line of radios include some of the most compact mobile and portable radios available. These radios feature a wide variety of power and feature combinations to meet virtually every application. And, best of all, these small packages carry small prices, too!

#### SM Series Mobiles: (above)

- ▲ 40 watts power VHF (150-174 MHz)
- ▲ 25 watts power UHF (450-482 MHz)
- ▲ 16 or 99 channel capability with Scan
- ▲ Built-in CTCSS & DCS
- ▲ Extremely easy, user friendly operation

#### SL Series Mobiles: (above)

- ▲ 40 watts power VHF (150-174 MHz)
- ▲ 25 watts power UHF (450-482 MHz)
- ▲ 6 channel capability with pre-set squelch
- ▲ Built-in CTCSS, DCS & Two Tone Sequential

#### PT Series Portables: (above)

- ▲ 5 watts power VHF (150-174 MHz)
- ▲ 4 watts power UHF (450-512 MHz)
- ▲ 6 channel capability without scan
- ▲ Built-in CTCSS, DCS and Two-Tone Sequential — Great for Talk-Back Paging applications

#### WHS150 Series Portable: (left)

- ▲ 4 watts power UHF (450-482 MHz) (482-512 MHz)
- ▲ 5 watts power VHF (148-174 MHz)
- ▲ 16-channel capability with scan
- ▲ Built-in CTCSS and a full function keypad for DTMF encode / decode and programmable ANI.
- ▲ Easy to use with new, more comfortable ergonomic shape

**RELM**  
COMMUNICATIONS

7707 Records Street  
Indianapolis, IN 46226  
1-800-821-2900

AN ADAGE COMPANY

In Canada, Call:  
Tad Radio of Canada, Inc.  
3101 29 Ave.  
Vernon, BC V1T 1Z2  
604-545-1150





**TP-3200** \$279.95

Full Featured Shared Repeater Tone Panel with ALL 157 CTCSS/DCS codes. In Desktop or Rack Mount version.



**CSI-100** \$749.95

Video Modem. Sends and receives broadcast quality, single frame, color video over ANY narrow-band communications channel.



**ID-8** \$89.95

Automatic Morse Station Identifier. Meets all FCC ID Requirements. Fully field programmable with included keypad. 1.85" x 1.12" x .35"



**TE-64** \$79.95

Self-contained Encoder, Rotary Dial Selection. Great for the Benchtop. 5.25" x 3.3" x 1.7"



**CC-1/CR-1** \$49.95 each

Surface Mount Component Kits for repairing SMT circuits. CC-1 for capacitors/CR-1 for resistors.



**PE-1000** \$224.95

Desktop Paging Encoder. Two-tone sequential, other formats available. 7.5" x 7.8" x 2.7"



**PE-2P** \$54.95

Two-tone Sequential Encoder. Sub-assembly mounts inside radio or other enclosure. Multiple call capability. 1.25" x 2.0" x .4"



**SD-1000** \$59.95

Two-tone Sequential Decoder. Programmable unit provides switched outputs from two-tone paging calls. 1.25" x 2.0" x .4"



**DTD-1** \$59.95

Single Function DTMF Decoder. Provides switch outputs via DTMF. 1.25" x 2.0" x .4"



**PE-4/PE-15** \$99.95

Multiple Call POCSAG (RPC-1) Paging Encoders. Where direct control of local area paging is desired. 1.78" x 1.03" x .35"



**DCS-23** \$59.95

Digital Coded Squelch Encoder-Decoder. Programmable to all codes. 1.36" x 1.18" x .25"



**TS-32P** \$57.95

Programmable CTCSS Encoder-Decoder. Tone squelch for any FM transceiver. 1.25" x 2.0" x .4"



**TS-64** \$64.95

Sub-miniature Programmable CTCSS Encoder-Decoder. 1.7" x .78" x .25"



**SS-32SMP** \$27.95

Sub-miniature CTCSS Encoder. Jumper programmable. .53" x 1.0" x .16"



**SS-32PA** \$28.95

Programmable CTCSS Encoder. Custom tones or audible tones also available. .9" x 1.3" x .4"

# The Sky's The Limit!

For over 25 years... bringing you tone signalling products that are as reliable as the day is long. Combine this with same-day shipping, toll-free technical support, and our no hassle one year warranty, and you'll realize the

sky's the limit in our efforts toward customer satisfaction.

Shown are a few of our most popular tone signalling

products. Call for details on these and all your tone signalling needs. A free catalog will be mailed upon request.

**COMMUNICATIONS SPECIALISTS, INC.**  
426 WEST TAFT AVENUE • ORANGE, CA 92665-4296  
(714) 998-3021 • FAX (714) 974-3420  
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547

